MORE THAN MEETS THE EYE

Studies on Upper Palaeolithic Diversity in the Near East

Edited by

A. Nigel Goring-Morris
and Anna Belfer-Cohen

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Front cover: Refitted core from Nahal Nizzana XIII (photo: Z. Radovan)
Back cover: left, Advat area with Boker Tachtit and Boqer; right, Ohalo II (photo courtesy of D. Nadel)

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Foreword

Reading More than Meets the Eye: Studies on Upper Palaeolithic Diversity in the Near East – Or Why You Should

The volume before you is an important one. It is clearly important for specialists working on Near East Pleistocene lifeways because it brings together most of the key players and has them direct their attention to a specific topic- the diversity in the archaeological record between some 50 and 10,000 years ago. For me the book's importance, however, lies beyond a 'state of the art' synthesis of a regional record at a specific point in time. This is because the volume addresses a seminal issue relevant to all scholars interested in understanding the past – namely, the significance of the observed diversity in the record.

The contributors to this volume amply document great variability in the archaeological remains recovered at one point in time from an area of some 140,000 km^2 of the occupied Upper Palaeolithic *oecumene*. Such synchronic variability in what was less than 1.0% of the total landmass occupied by our ancestors warns us to expect similar synchronic diversity in all of the areas outside of the Near East as well. And this is, in fact, precisely what is being observed more and more from other well studied areas such as France, Moravia, and Russia – in both its European and Siberian parts.

Various chapters in this volume also document variability through time. While our chrono-cultural schemes which see Middle Palaeolithic industries replaced by Upper or Late Palaeolithic ones certainly lead us to expect such change through time, a number of the authors in the ensuing pages also argue for synchronic diversity in archaeological remains recovered from sites dating to the transition from the Middle to the Upper Palaeolithic and thus point to different pathways likely taken to modern human lifeways ostensibly achieved some 40,000 years ago.

The documentation of variability in the archaeological record necessarily raises the question about its meaning and significance. Synchronic and diachronic diversity clearly reflects many factors. First, variability increases with an increase in the volume of the record on hand. The more sites we know in a region, the longer research has been conducted there, or the more scholars who have worked with that record – the greater the changes to see diversity. The direct positive relationship between abundance and diversity is a well known statistical phenomenon, one highlighted for prehistoric archaeologists by scholars working on various measures of diversity (see discussion in Kerry and Henry, this volume). Given this, it is less than surprising then to find in 'the history of prehistory' that while our l9th and early 20th century predecessors stressed mean/modal tendencies, those of us working a century later problematize variability.

It is also true, as some contributors to this volume point out, that greater variability is perceived when scholars from different research traditions work with analogous data. The Near Eastern research record is a veritable 'Tower of Babel' in this respect, with knowledge and insights having been generated by scholars hailing from Great Britain, France, Israel, the United States, and Japan. Next, as Belfer-Cohen and Goring-Morris point out in their introductory chapter, in archaeology as in paleoanthropology personal paradigmatic preferences are also at play – with some scholars highlighting central tendencies and thus leaning towards 'lumping' while others place greater value on differences and privilege 'splitting'.

When we combine these factors with the inescapable reality that in archaeology, especially in lithic studies, the vast majority of variables we work with are not discrete but continuous, little wonder than that our end products wind up as polyphonic interpretations.

Acknowledging all this necessarily puts us before the first crucial question: namely, is the observed variability – be it through time or across space – just a product of our and our predecessors' research contexts? I believe that the volume before you convincingly demonstrates that no, the diversity they observe is not only of our own making – something created by researchers themselves. Rather, some – and just how much remains to be established – came about through the diverse actions of people who lived in the Near East during the late Pleistocene.

Having demonstrated this, many of the contributors to *More Than Meets The Eye: Studies on Upper Palaeolithic Diversity in the Near East* then proceed to examine a variety of potential generators of this variability. All 'the usual suspects' are considered from climate and culture

and the different capacities all the way to possible differences in social organization, in styles of teaching and learning, and finally in 'ways of being in the world'. The strength of this volume lies precisely in the variety of options considered and in the fact that while different authors may favor one explanation over another for the record at a particular point in time, at other times or in other places they champion different explanations as being more satisfactory. This inexorably underscores the importance of contingency or 'history' – something rarely considered in Palaeolithic archaeology.

Another major issue considered in this book that I find significant beyond the confines of the Palaeolithic Near East is the question of what spatial scale to select as our unit of study. A number of contributors find our traditional focus on a single site satisfactory, yet for others – often asking different questions – a single site is insufficient. Although the way we choose to organize our research today as well as our research traditions do favor a single site – such an analytic unit is clearly too small when problematizing diversity and its significance or lack thereof.

I am also happy to see that this volume indirectly raises one of my favorite questions: was Palaeolithic life lived by stone alone? If not, as clearly was the case - then why do we still continue our lithocentric focus when working on prehistory? Some authors invoke preservation biases that inevitably come in once we try to operationalize such awareness. While admittedly organics do, indeed, not preserve at some sites, should this absolve us from the need and the duty to not only study such more perishable remains as diligently and exhaustively as we do the lithics, but also to routinely employ recovery techniques designed to optimize our chances of recovering them? The most glaring example of our failure to do so, as Phillips and Saca note, is the fact that while water screening is used at most, if not all, Palaeolithic excavations – flotation is most assuredly not. The two are not equivalent – the first can and does destroy such perishables as charred plant materials. Given such destructive recovery methods little wonder then that we fail to routinely recover vegetal remains from Palaeolithic contexts.

In light of the history of Palaeolithic archaeology, it is clearly hard – or at least bothersome and in some quarters almost un-archaeological to think beyond lithics. Yet, as the different contributors to this volume as well as its editors reiterate – the study of these durables is problematic as well. While not too long ago a typological analysis was seen as necessary and sufficient, today such studies need to co-exist with technological ones, most notably exercised through the *chaîne operatoire* approaches amply discussed in this volume. We have become much more sophisticated in our study of tool types over the last century and today we clearly need to bring as much sophistication to our studies of technology. We need to ascertain if technological criteria are more discrete and significant as well as to consider if tool types and different *chaînes* are proxies of the same or of different prehistoric phenomena. Simply put – to paraphrase Spector (l994) – we need to address just 'what does this *chaîne* mean?' Typological studies have taught us that the final tool we examine is a complex product resulting from an interface of structure and contingency. Does the discovery that different *chaînes* were used coterminously, as reported by Nadel in this volume for example, show that technological choices resulted from similar constellations?

Since this volume focuses on Upper Palaeolithic variability, some of its contributors necessarily touch upon the perennial favorite topic of Palaeolithic research – namely 'the Transition' or the significance or non-significance of the differences between the Middle and the Upper Palaeolithic inventories. As can be expected, their opinions are split on this as they are on the question of regional continuity or discontinuity of this transition. Although, like a myriad of other recent volumes on this 'hot topic' most of the contributors to this book also appear to have a hard time conceptualizing the pre-transition 'other' – outside of standard 'diagnostic' list of flake *vs.* blade tools, inorganic *vs.* inorganic + organic inventories, *etc.* – the sum of their contributions does document that different paths were taken in this transition. I find this a major contribution because not only does this show that there were choices in how to become 'modern', but necessarily also raises the most important question heretofore not confronted head on by our scholarship on the transition. Specifically, once we realize that the criteria we use to differentiate the Upper or Late from the Middle Palaeolithic are highly slippery to begin with, and that most of them are relative rather than absolute, we come face to face with the need to define what exactly we consider to be 'modern' behavior. Such a definition has to be valid through ethnographically known time and space and to have material expressions that can be used as its proxy measures. Although this volume does not offer such a definition of 'modernity', by confronting and problematizing diversity it brings us to the logical next step – one that involves questioning and then refining our assumptions.

And finally, although this volume resulted from a conference on the subject, its editors – A. Belfer-Cohen and N. Goring-Morris, have done an exceptional job in turning the final product into a focused, coherent whole. This was likely not an easy task – riding herd over authors who represent a definitive 'who's who' in Palaeolithic research in the Near East never could be. Their product, one in your hands now, is far more than a proceedings volume. It is, instead, a veritable benchmark of what we know, as well as a chart of what we need to find out.

Olga Soffer

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Preface

The Upper Palaeolithic of the Near East has been a focal topic of prehistoric research for quite some time. Indeed the Near Eastern record of human prehistory has provided a plethora of data pertaining to the emergence and development of the Upper Palaeolithic, considered to represent the institutionalisation of modern human behaviours. This said, it is of interest to note that while research has been continuous, the conceptual frameworks, necessary for comprehending the material culture remains of the period were construed on a sporadic basis, the changes reflecting both new data as well as new paradigms and theories in prehistoric research in general.

The current guidelines for Upper Palaeolithic research in the Levant were formulated more than 20 years ago (Gilead 1981a, b; Marks 1981a, b). This then new and revolutionary vision of the Upper Palaeolithic focused on the recognition of more than one contemporary cultural tradition within the period. It was founded primarily on the emerging evidence from the arid zones of the southern Levant, as well as reconsideration and new studies of finds from the Mediterranean region. Unfortunately, the material culture remains that served as the basis for the aforementioned hypothesis are limited in scope, with chipped stone techno-typology forming the vast bulk of the evidence.

Even at that time, some researchers were uneasy concerning certain aspects of the new paradigms. Following considerable subsequent field research in previously unknown areas, whether in Transjordan or the northern Levant, as well as the reinvestigation or publication of previously excavated sites, perusal of the literature indicates that such sentiments have multiplied over the years.

In light of all this, it seemed to us that there was a need to reconsider, modify, and perhaps even critically question aspects of the available conceptual framework. Accordingly, we decided to coordinate a small symposium focusing on and summarising the results of recent fieldwork and related lithic studies. The present volume thus derives from a session on the Levantine Upper Palaeolithic that we organised at the 65th annual meeting of the Society for American Archaeology (Philadelphia PA, April 2000). Various participants and members of the audience subsequently expressed interest that the papers presented there be published. While the focus in Philadelphia was primarily limited to the 'nuts and bolts' of chipped stone studies, we felt that it would be useful for a publication to widen the scope, and approach others who had not participated in the SAA session in order to include studies on the environment and other related issues. We also endeavoured to engage in this enterprise those scholars who formulated the Upper Palaeolithic research paradigms of the 1980s and who have pursued such research interests or kept updated on ongoing Upper Palaeolithic research, as well as newcomers to the field, engaged in more recent studies. We were fortunate to receive contributions from most of the leading (then and now) persons in the field of Levantine Upper Palaeolithic research. We regret that I. Gilead could not participate in the present volume. While R. Ferring did present a lecture at the SAA session, he could not provide a written version. Unfortunately, we were also unable to elicit a contribution dealing with the new Upper Palaeolithic data emanating from the important site of Umm el-Tlel in Syria. On the other hand, and in light of the size of the volume, we made a conscious decision to focus on the Levant, and to exclude recent research from southern Turkey – Karain and Okuzini (Otte *et al*. 1995 a, b, 1998; Yalçinkaya *et al*. 1992, 1995; Yalçinkaya and Otte 1999) – as well as reinterpretations of the older Zagros collections (Olszewski 1993, 1994).

The volume in its final form comprises 23 chapters. Following the introduction, presenting an overview of past and current research issues, we have grouped the papers into six principle thematic sections, hopefully without imposing our own views too forcefully. These deal with: environment and resources (Bar-Matthews and Ayalon, Goldberg, and Rabinovich), the Middle to Upper Palaeolithic transition (Chazan, Tostevin, Sarel and Ronen, and Fox); the early Upper Palaeolithic (Phillips and Saca, Kuhn *et al*., Monigal, Becker, Coinman, and Kerry and Henry); flake-based assemblages (Bergman, and

Williams); the later Upper Palaeolithic and the transition to the Epipalaeolithic (Kaufman, Nadel, and Olszewski). It can been seen that research in recent years has focused especially upon the Ahmarian-related industries, seemingly reflecting the actual relative densities of the various entities on the ground, in contrast to previous notions, whereby the generic Aurignacian seemed predominant. In keeping with the format of the SAA session there are three contributions (by Bar-Yosef, Copeland, and Marks) written in light of access to the papers submitted, and it is of some interest to note the disparate directions that each commentator has chosen to follow. Finally, we have added an epilogue in which we present our personal outlooks, while attempting to highlight matters of consensus and division, and outlining possible avenues for further research.

Given the pronounced climatic changes during the late and terminal Pleistocene that have now been more clearly defined, chronological resolution and correlation with cultural changes are, naturally, of paramount importance. In light of imminent possibilities for extending calibration back through the entire span of the Upper Palaeolithic (*e.g.*, Beck *et al.* 2001), it is important to note that all 14C dates quoted in the volume are given as uncalibrated bp, while for calendric radiometric methods the dates are expressed as ky. An appendix provides a comprehensive list of available Upper Palaeolithic 14C dates in the Near East. Since a considerable portion of the bibliographic references in each chapter is often repetitive we decided that a centralised, combined bibliography is preferable, providing a detailed and relatively comprehensive reference source for Upper Palaeolithic studies throughout the Near East.

We gratefully thank all those who participated in the SAA session or subsequently agreed to submit papers, subjecting themselves to critical reviews by both the editors and a reviewer. We thank and especially appreciate the unsung efforts and valuable insights of the latter, who chose to remain anonymous. We thank Ofer Bar-Yosef for suggesting the idea of organising the original symposium within the framework of the SAA. Thanks are also offered to Erella Hovers for suggesting the title of the volume.

We hope that besides the knowledge provided by the contents of this book, it will also provide a fertile ground for the germs of the imminent malcontent with these ideas for the 2000s – such is the nature of research and modern behaviour….

Nigel Goring-Morris and Anna Belfer-Cohen
Jerusalem February 2002

1. Current Issues in Levantine Upper Palaeolithic Research

Anna Belfer-Cohen and A. Nigel Goring-Morris

Introduction

It is easy to dismiss the Near Eastern Upper Palaeolithic as being grey in comparison to the wonders of its European counterpart. In many ways the Upper Palaeolithic can be considered as an anti-climax to the story of the Neanderthals and *Homo Sapiens* and their interrelationships, especially within the Near East. Yet, it is specifically this 'boring' period that can be considered as the first undoubted link in the great chain of modern human 'being' in the region. It culminated when yet another hunter-gathering group altered the basis of human existence. It is these 'murky waters' that demand the utmost of prehistoric archaeology as a scientific domain.

What then, exactly is the meaning of the 'Upper Palaeolithic', and what does the term 'Upper Palaeolithic' specifically represent (as opposed to the 'Middle Palaeolithic' or the 'Neolithic')? Neanderthals, and indeed even some of their forbears, were clearly competent hunter-gatherers with behaviours including relatively sophisticated social and even ritual aspects. With regards the Neolithic the differences are self-evident. But with respect to differences between the Middle and Upper Palaeolithic, the Near East definitely occupies a crucial position, whether or not the initial processes of the transition originated here, or whether the Levant merely represents the bridgehead for Upper Palaeolithic movement into Eurasia. Of course, this does not address the question as to whether it involved actual migration, replacement, or acculturation (Klein 2000; Mellars *et al*. 1999; Zilhao and d'Errico 1999).

History of Research Processes

We present here only a very brief outline of the principle research issues concerning the Upper Palaeolithic of the Near East (for a more detailed treatment see, *e.g.*, Gilead 1991). In reality research has historically focused primarily on the Levant (the area bounded between the Taurus/Zagros and the Red Sea on the one hand, and the Mediterranean and the Saudi Arabian desert on the other – see Fig. 1.1).

The initial unilinear six-phased model proposed by both Neuville (1934) and Garrod (1951) was essentially Euro-centric in outlook, and was based on the sequences in the cave and rockshelter sites of the Carmel (Kebara, el-Wad) and the Judean Desert (Erq el-Ahmar, el-Khiam) known prior to World War II. Thereafter debate on issues concerning the Upper Palaeolithic of the Near East largely revolved around that conceptual framework (though see Garrod 1957; Copeland 1975). Intensive research in the 1960s resulted in the separation of the Upper Palaeolithic phase VI and the Mesolithic Natufian into a distinctive time unit, namely the Epipalaeolithic (Perrot 1968; Bar-Yosef 1970). In light of the publications emanating from field research in the desert regions of the southern Levant during the 1970's, the unilinear model was replaced by a radically new hypothesis encompassing the entire Levant. This new approach posited the presence of parallel Upper Palaeolithic phyla involving the newly defined Ahmarian in addition to the previously identified Aurignacian 'tradition' (Gilead 1981a, b; Marks 1981a, b). Additionally, investigations at Boker Tachtit provided crucial evidence concerning the Middle to Upper Palaeolithic transition (Marks 1983a, b), demonstrating both the early dates for the shift locally in comparison to Europe, and the notion that, in the Levant at least, the local late Mousterian seemingly developed into the earliest Upper Palaeolithic (but see Tostevin herein).

The revolutionary notion that there are more Upper Palaeolithic cultural entities than the Aurignacian and its derivatives was reinforced by several lines of evidence. These included new discoveries (*e.g.*, in Kebara cave), publication of previously excavated sites (*e.g.*, Ksar Akil rockshelter), and reinterpretation of finds (*e.g.*, from Kebara and Qafzeh caves and the Yabrud rockshelters), almost all located in the Mediterranean region (Azoury 1986; Bar-Yosef *et al*. 1992, 1996; Belfer-Cohen and Bar-Yosef 1999; Bar-Yosef and Belfer-Cohen in prep.; Bergman 1987a; Ohnuma 1986, 1988; Rust 1950; Bachdach 1982).

Recent Research

Levantine Upper Palaeolithic research over the past two decades has expanded markedly. This relates both to geographical scope, with major field projects in Jordan – Wadi Hasa, the Petra area, Ras en-Naqb (Coinman 2000; Coinman and Henry 1995; Schyle and Gebel 1997; Schyle and Uerpmann 1988; Henry 1997; Kerry 2000); Sinai – Abu Noshra, Qadesh Barnea, Ain Qadis (Phillips 1988, 1991; Becker 1999; Gilead and Bar-Yosef 1993; Goring-Morris 1995a); the Negev – Har Horesha, Shunera (Belfer-Cohen and Goring-Morris 1986; Goring-Morris 1987); Syria – Umm el-Tlel (Molist and Cauvin 1990; Ploux 1999); and renewed excavations at some Mediterranean zone sites – Kebara and Qafzeh caves (see references above). Various overviews have incorporated much of this new data (*e.g.*, publications by Gilead 1991; Copeland 1997; Bar-Yosef 1998; Bar-Yosef and Belfer-Cohen 1996; Belfer-Cohen and Bar-Yosef 1999; Phillips 1994, amongst others). Nevertheless the Upper Palaeolithic of the Levant, let alone that of the entire Near East, remains poorly known. Stratified sites are scarce, and absolute dates are relatively few (see Appendix), some being obtained many years ago and thus should be viewed with caution. Additionally, there are numerous questions as to the beginnings of the Upper Palaeolithic, the interrelationships between its various entities and the transition to the Epipalaeolithic.

These, coupled with the new finds, require a new '1968' conference (unpublished, but see Bergman 1987a). A previous endeavour which attempted to emulate the former, also in London, during 1987 was arguably less influential in creating a common consensus and/or common definitions, that might have enabled researchers to communicate their finds and express their ideas on the nature of Upper Palaeolithic phenomena. Indeed it was clear that a considerable diversity of opinion was already emerging (Bergman and Goring-Morris 1987).

In trying to present the highlights of the past two decades in Upper Palaeolithic research, perhaps the first thing that comes to mind is the dramatic change, from a linear model of Upper Palaeolithic developments to a model encompassing two largely parallel phyla. These are the 'Ahmarian' and the 'Levantine Aurignacian'. The treatment of the various assemblages pertaining to those phyla can well illustrate the current state of research.

The newer taxon, the Ahmarian, has been known since the initiation of systematic research, yet preconceptions barred awareness of this variability (*e.g.*, Qafzeh and Erq el-Ahmar caves, see Neuville 1951). We believe this should be a cautionary tale in our present understanding of the Upper Palaeolithic. Rather than automatically assigning newly discovered assemblages within the two-tradition model (as was done previously within the single strand approach), we should be aware of the potential complexities of Upper Palaeolithic developments throughout the Near East.

For there are more than the 'Levantine Aurignacian' or 'Ahmarian' names floating around. We shall briefly present the *dramatis personae* populating the main body of the Upper Palaeolithic period, if only as indications and illustrations of the apparent variety. There are questions as regards these archaeological entities that have been addressed in the past, yet continue to be relevant both at the level of middle range research theory, as well as on a more pragmatic plane. What is the relevance of the various assemblage groupings (Clark 1997; Barton and Neeley 1996; Neeley and Barton 1994)? What are the interrelationships between all these entities, should we try to lump them together or treat them separately, and which way is better for research?

A Brief Outline of the Levantine Upper Palaeolithic

We have decided to include within the Upper Palaeolithic all the presently recognized entities dating to the interval from *ca*. 45,000 to 20,000 years ago. Of course these are arbitrary cut-offs, with the Middle to Upper Palaeolithic transition being accredited much more attention and importance than the Upper Palaeolithic to Epipalaeolithic one. The Middle to Upper Palaeolithic transition brings to mind the story of the 'losing' Neanderthals and 'winning' *Homo Sapiens* and the whole issue of trying to find out if and what were the Upper Palaeolithic characteristics that brought about the demise of the 'good old' Middle Palaeolithic world, which had lasted for such a long duration (well over 100,000 years). The transformation of the Upper Palaeolithic into the Epipalaeolithic is relatively smooth and the division between these two periods has become more blurred than was previously assumed. So much so that there have been proposals to discard the use of the Epipalaeolithic term altogether, or cut it's duration dramatically, from the conservative estimate of 10,000 years to merely 4,000 years and less (Gilead 1984a, 1988; 1991; and see Appendix for dates).

The site of Ksar Akil, with its long Upper Palaeolithic sequence continues to serve as a benchmark or 'standard' for the Upper Palaeolithic sequence throughout the Levant. Yet the mosaic nature of environments in the Levant should be borne in mind. From this perspective the relative geographical isolation of Ksar Akil and other sites in Wadi Antelias, bounded by the Lebanese mountains on the one side, and the Mediterranean on the other, needs to be taken into account. This may, to some extent at least, contribute to understanding the inherent difficulties of fitting the techno-typological succession displayed by Ksar Akil into the wider framework of developments throughout the Levant.

The basic building blocks of the relevant archaeological entities that we recognize include:

1) Transitional/Initial/Emiran (*ca*. 45–38,000 bp)(Fig. 1.1)

It is clear today that more than one variant represents the Middle to Upper Palaeolithic transition in the Levant.

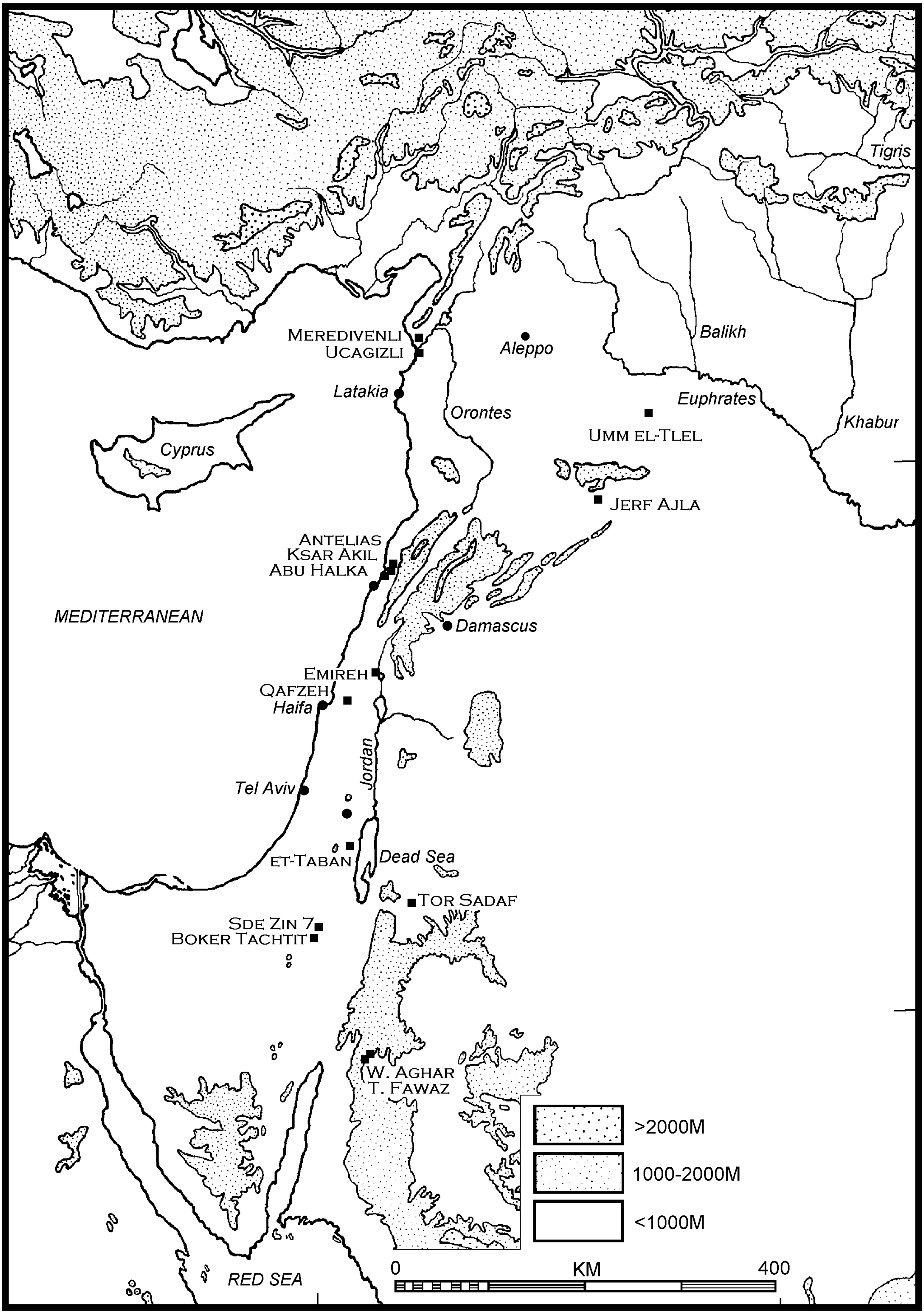

*Fig. 1.1 Distribution of Transitional Middle to Upper Palaeolithic and Initial Upper Palaeolithic (*ca. *45–38,000 bp) sites in the Levant.*

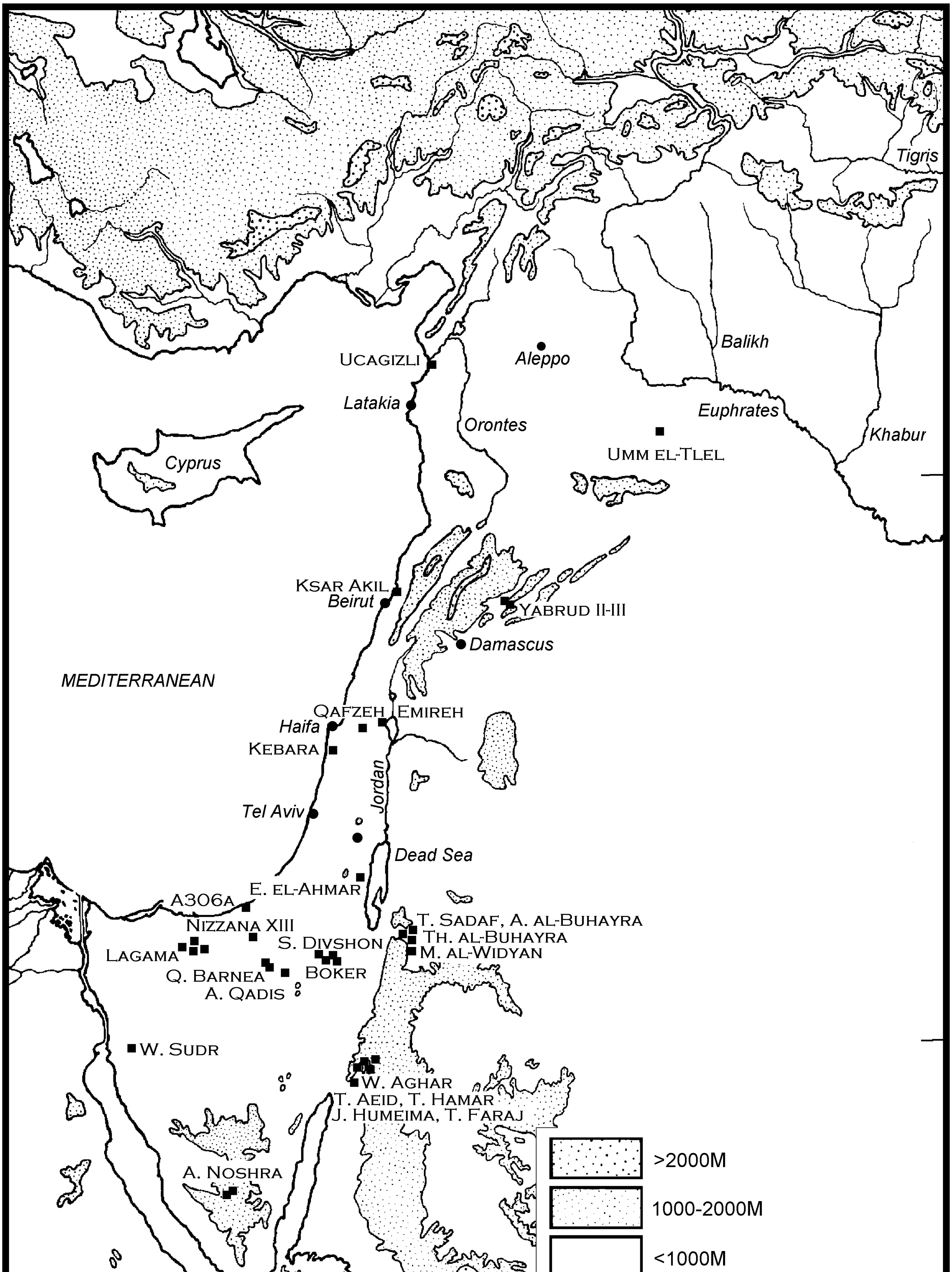

*Fig. 1.2 Map showing Early Ahmarian and related (*ca. *38/36–25,000 bp) sites in the Levant.*

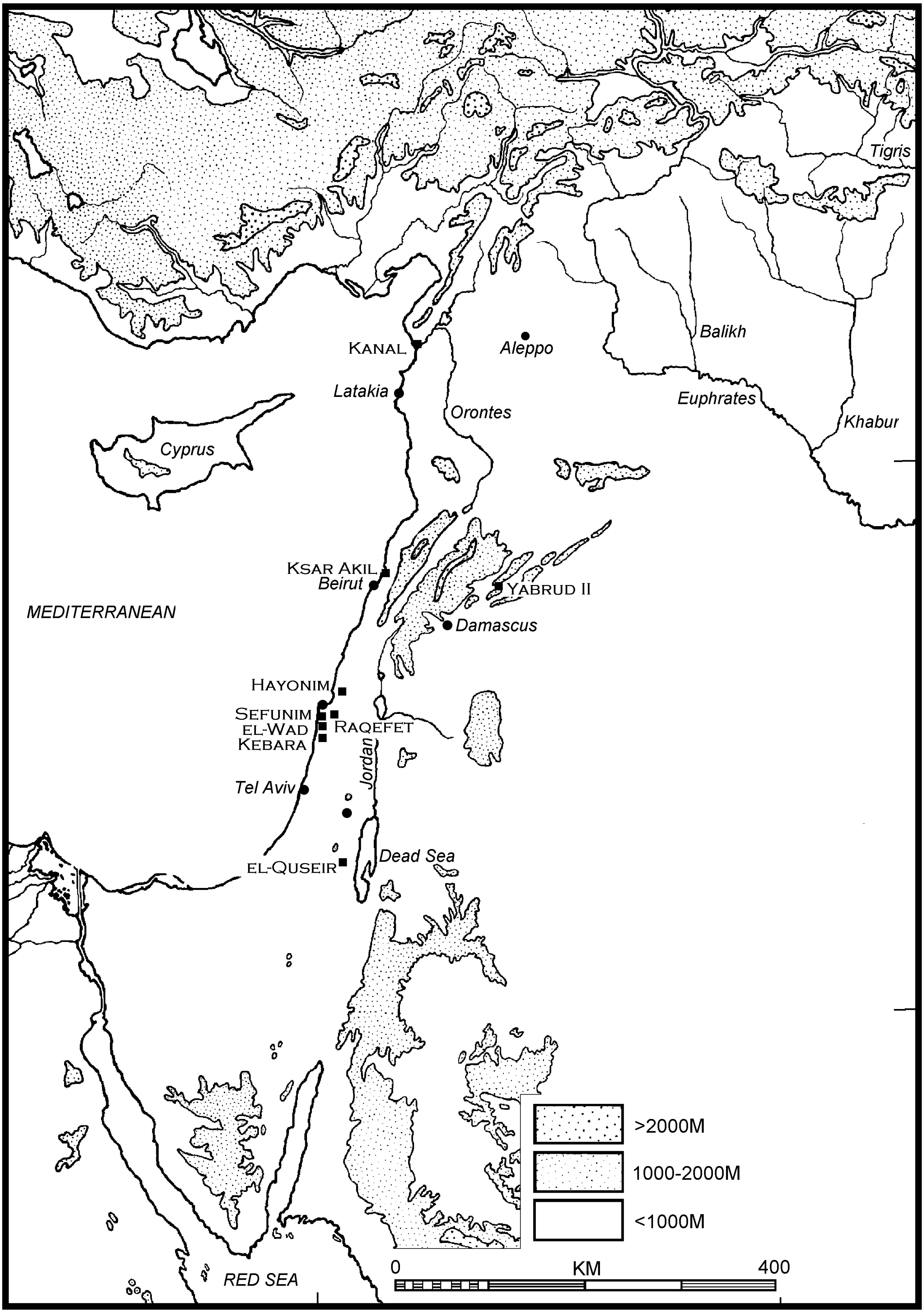

*Fig. 1.3 Map of Classic Levantine Aurignacian (*ca. *32–26,000 bp) sites in the Levant.*

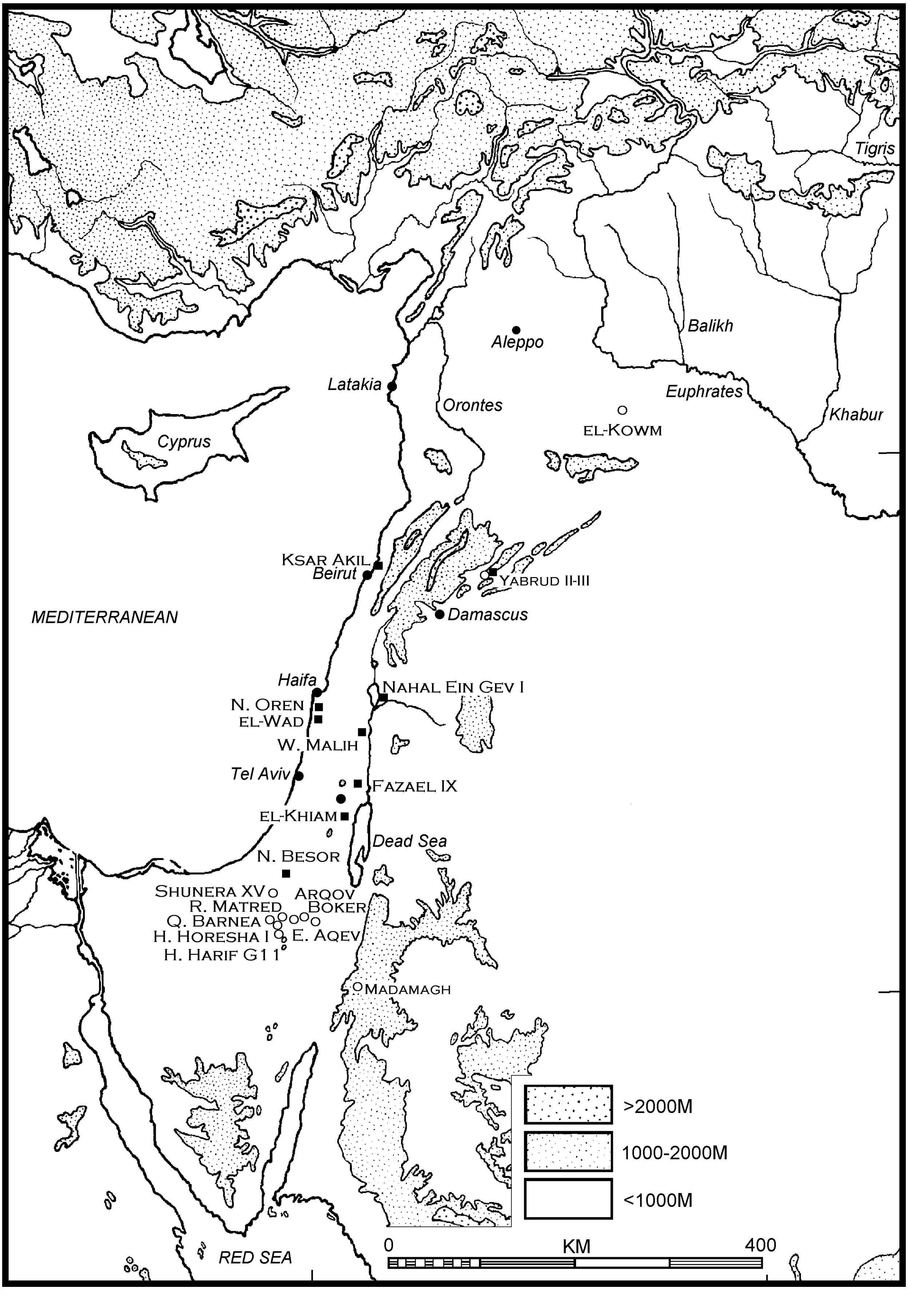

*Fig. 1.4 Distributions of Atlitian (*ca. *?27/26,000 bp) (solid squares) and Unnamed flake-based occurrences (*ca. *?30–17,000 bp) (open circles) in the Levant. Note the largely discrete distributions.*

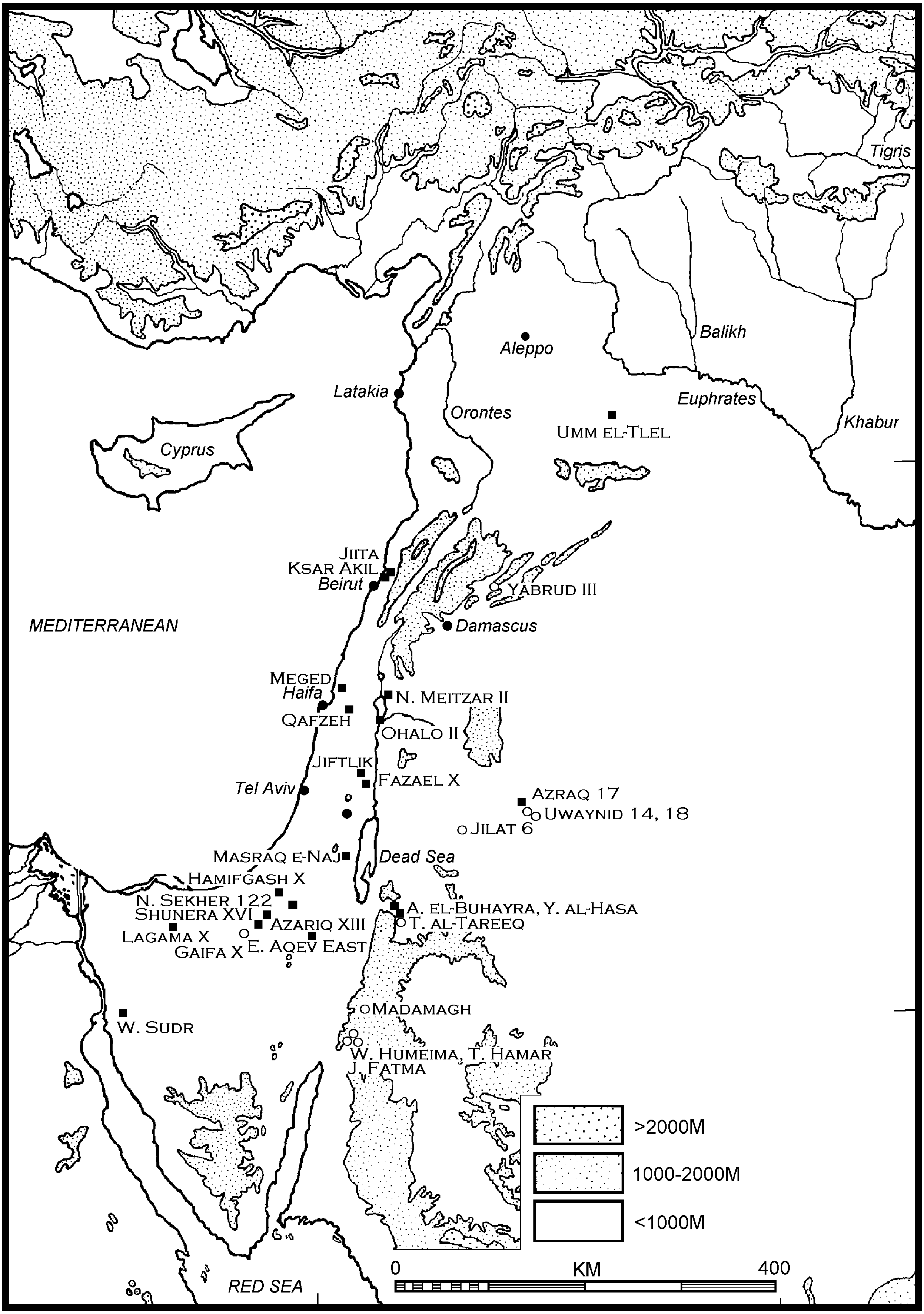

Fig. 1.5 Distributions of Transitional Upper Palaeolithic – Early Epipalaeolithic entities in the Levant. Masraqan/'Late Ahmarian' (ca. *22–16,000 bp) (solid squares) and Nebekian sites* (ca. *22,000–20,000 bp) (open circles). Note that the latter are confined primarily east of the Rift Valley.*

Relevant sites include: Boker Tachtit, Emireh, Ksar Akil, Umm el-Tlel, Üçağızlı, and sites in southern Jordan (Tor Fawaz, Tor Sadaf) (Garrod 1951; Marks 1983a, b; Azoury 1986; Copeland 1975; Neuville 1934; Bourguignon 1986, 1988; Boëda and Muhesen 1993; Kuhn *et al*. 1999; Coinman and Henry 1995; Coinman and Fox 2000). Among the shared characteristics of the transitional industries is the dichotomy between technological and morpho-typological changes, while characteristic *fossiles directeurs* include the Emireh point and the *chanfrein*.

2) 'Early Ahmarian' (*ca*. 38/36–25,000 bp)(Fig. 1.2)
The Early Ahmarian/Lagaman is distributed throughout the southern and northern Levant. In the south it includes: the Lagama, the Boker, and the Qadesh Barnea sites, Abu Noshra, south Jordan sites, and Erq el-Ahmar E/F (Bar-Yosef and Belfer 1977; Ferring 1976, 1988; Marks 1976a; Gilead and Bar-Yosef 1993; Phillips 1991; Becker 1999; Coinman 2000; Neuville 1951). Further north are the sites of: Ksar Akil XX, Qafzeh E?/D (8–9), Kebara E (IV–III)?, Umm el-Tlel, and Yabrud II/6–5 (Ohnuma 1988; Bergman 1987a; Neuville 1951; Bar-Yosef *et al*. 1992, 1996; Boëda and Muhesen 1993; Rust 1950; Bachdach 1982). An important issue concerns the similarities and differences between the various assemblages in both regions. More or less standardized blade blanks and tools comprise an important component of all Early Ahmarian industries. The el-Wad (Font Yves) point initially was cited by Garrod (1957) as a *fossile directeur* of the Levantine Aurignacian industries. Yet, today the primary association of this rather amorphous type is within 'Ahmarian' contexts.

3) The 'Classic' Levantine Aurignacian (*ca*. 32–26,000 bp)(Fig. 1.3)
Most of these sites are located in the north or central Mediterranean Levant: Ksar Akil VII, Yabrud II/1–4, Hayonim D, el-Wad D, Kebara D (I–II), Raqefet(?), and el-Queiseir (Rust 1950; Bachdach 1982; Bergman 1987a; Dortch 1970; Belfer-Cohen and Bar-Yosef 1981; Garrod and Bate 1937; Garrod 1954; Bar-Yosef *et al*. 1992, 1996; Ronen 1984; Ziffer 1978, 1981; Perrot 1955). Until recently, and especially following the initial definition of the 'Ahmarian', all 'flake-based' assemblages were assigned to the 'Levantine Aurignacian'. Yet considerable diversity is apparent, on both spatial and chronological levels. These have major implications concerning the integrity of the taxon. To date such assemblages are restricted to the Mediterranean coastal zone. For the purposes of this review we include here only those assemblages displaying 'classic' Aurignacian features, *i.e*., nosed and shouldered carinated items on flake blanks, Dufour bladelets, scalar retouched items, *etc*. not to mention a rich bone and antler industry.

4) 'Atlitian' (*ca*. ±27/26,000 bp)(Fig. 1.4)
Most of the sites assigned to this entity are also centred in the more northerly Mediterranean zone: Ksar Akil VI, Meged, el-Wad C, Nahal Ein Gev I, Fazael IX, and el-Khiam E (9–10). These are a mixed variety of assemblages – note that el-Wad C is quite different from both Nahal Ein Gev I and Fazael IX, *etc*. (Garrod and Bate 1937; Bar-Yosef 1973; Goring-Morris 1980 a, b; Neuville 1951; Echegaray 1964, 1966; Kuhn *et al*. in prep.). This entity was originally defined on the basis of the assemblage from el-Wad C. Yet in recent years this taxon has been expanded to include assemblages featuring a flake-based technology with a preponderance of truncation burins, a virtual absence of blade/let production and very few typical 'Aurignacian' elements. The chronostratigraphy remains poorly defined.

5) Unnamed flake-based entities (*ca*. 30–17,000 bp?)(Fig. 1.4)
This apparently late Upper Palaeolithic entity is distributed primarily in the arid zone of the Levant. Sites include: Har Horesha I, Arqov/Avdat (Ein Aqev/Boker C), Qadesh Barnea 602(?), Qseimeh II, Ramat Matred/Har Lavan, and Shunera XV in the Negev and Sinai, as well as Madamagh and others in the el-Kowm region east of the Rift Valley (Marks 1976b; Jones *et al*. 1983; Belfer-Cohen and Goring-Morris 1986; Larson and Marks 1977; Phillips 1994; Gilead 1981b, 1993; Goring-Morris in prep.; Schyle and Uerpmann 1988; J. Cauvin pers. com. and pers. obs.). These assemblages are characterized by laterally carinated items on thick flakes that differ significantly from classic Aurignacian carinated items (which are *not* laterally carinated). Many of these assemblages were initially included within the 'Levantine Aurignacian' tradition, *e.g.*, the 'Arqov/Avdat' industry (see Gilead 1991; Marks 1981a).

6) Masraqan ('Late Ahmarian') (*ca*. 22–16,000 bp)(Fig. 1.5)
Many, but not all of these late Upper Palaeolithic/early Epipalaeolithic sites are located in the more marginal regions of the Levant: Ksar Akil III–IV, Umm el-Tlel, Meged, Ohalo II, Fazael X, Masaraq e-Na'aj, Nahal Sekher 122, Ein Aqev East (D34), Azariq XIII, Shunera XVI, Lagama X, Wadi Sudr 6, Azraq 17 trench 2, Ain el-Buhira (WHS618), and Yutil el-Hasa (WHS 784) (Goring-Morris 1980a, b, 1987; Ferring 1977; Perrot 1955; Nadel *et al*. 1995; Ploux 1999; Goren and Gilead 1986; Baruch and Bar-Yosef 1986; Gilead 1977; Bar-Yosef 1970; Olszewski 2000; Kuhn *et al*. in prep.). These late Upper Palaeolithic assemblages were originally viewed as directly continuing the 'Early Ahmarian', and hence were designated as the 'Late Ahmarian'. Nevertheless, while basic technological similarities between the two are indeed obvious, all these later assemblages are characterized by an emphasis on bladelet production and multiple reduction strategies. The tools include high frequencies of narrow, finely retouched ('Ouchtata') bladelets (Ferring 1988; Goring-Morris 1995b; Goring-Morris and Belfer-Cohen 1997). There are almost no real el-Wad points, nor Aurignacian elements. Radiometric

dating indicates that these assemblages fall within the Upper to Epipalaeolithic transition (see Appendix).

7) Nebekian (*ca*. 22,000–20,000 bp)(Fig. 1.5)
The Nebekian has a geographical orientation focused primarily east of the Rift Valley. Radiometric and stratigraphic considerations indicate that it is approximately coeval with the Masraqan (indeed both may be viewed in general terms as Early Epipalaeolithic). Assemblages include: Yabrud III/4–7, Uwaynid 14 middle, Uwaynid 18 upper, and Jilat VI lower in the Azraq basin, Tor al-Tareeq in Wadi Hasa, Wadi Humeima, Jebel Fatma and Tor Hamar, as well as Wadi Madamagh in south Jordan, and perhaps also Gaiyfa X in Sinai (Rust 1950; Byrd 1988, 1998; Garrard *et al*. 1988a, 1994; Neeley *et al*. 2000; Henry 1995a, b; Becker 1999). The Nebekian is characterized by the production of narrow bladelet blanks, the initiation of intensive backing and the habitual application of the microburin technique.

Current Status of Research

It is impossible to cover here all of the issues pertinent to current Near Eastern Upper Palaeolithic studies. We intend to just touch upon some of the 'black holes' in current research, at least according to our perception of matters.

For example, how is it that so few distinct archaeological entities can be identified during the course of the Upper Palaeolithic as opposed to during the succeeding Epipalaeolithic? This is notwithstanding the relative duration of each period. Obviously the timescales of the two periods are of quite different orders of magnitude – some 25k yrs for the former *vs*. 10k yrs for the latter. Perhaps this has to do with a combination of relatively greater population densities, increased social awareness, and the emergence of more distinct evidence for territoriality. In this context it is of interest to note that the duration of each cultural entity in the Epipalaeolithic (as opposed to the Upper Palaeolithic and earlier periods) does conform to what some consider the legitimate duration of an archaeological culture:

> '… it is immediately apparent that all Paleolithic techno-typological modalities exist at a scale far beyond that of any conceivable social unit that might have transmitted them. So, whatever they mean, they have nothing to do with traditional ways of making stone tools. This, of course, implies that they have nothing to do with historical process, which in turn calls into question both the integrity and the utility of normative analytical concepts – Aurignacian, Mousterian, Perigordian, Chatelperronian, *etc*. ' (Clark 1997:68).

The significant difference in time depth between the Upper and Epipalaeolithic introduces also variability in geomorphological and taphonomic processes between the two periods that contribute to obscuring our comprehension of the former.

It is certain that our own apparent difficulties in observing archaeological phenomena influence the final results of these observations. Surely, the 'cultural' (*i.e*. techno-typological) markers that are currently used for the Upper Palaeolithic, by their very nature, do not permit us the same degree of precision as that enjoyed for the Epipalaeolithic – where the microlithic component provides better means for differentiation purposes. To cite an example from a totally different field of research – today it is possible to isolate and identify variants of proteins provided the right markers for racimisation are available. Consequently, although 'n' variants of the haemoglobin molecule are known, it does not necessarily follow that they represent *all* of the actual variants present. It simply reflects the number of markers currently available for identification purposes.

On the other hand it is possible that there are indeed fewer entities incorporated within the Upper Palaeolithic. If one accepts a deterministic approach, then variability has to do not only with function but also with location, resource availability, *etc*., just as the variability of the late Middle Palaeolithic is suggested to reflect increased territoriality stemming from changing climatic conditions, by the 'tightening' of social bonds and a retreat into areas with greater carrying capacities (see Hovers 2001). These are clearly matters that should be borne in mind, in addition to the social implications of modern human behaviour.

Besides having this uneasy feeling of indeed looking at Upper Palaeolithic archaeological entities 'through a glass darkly', there is the intractable methodological problem of competing 'lumpers' *vs*. 'splitters' camps. As Copeland forthrightly noted recently:

> 'What to do? Perhaps if an assemblage does not fit one or another model, workers should not force it to do so; they should 'tell it like it is' and continue to search for reasons for the variability' (Copeland 1997:189).

Since the above depends on the lithic criteria used for assigning the various assemblages to their respective phylum, something needs to be done about these criteria. Constructing a widely accepted conceptual framework is a matter of some urgency given the wealth of basic data currently available. This should be possible to achieve in light of the considerable progress that has been made as regards lithic studies, to mention but the '*chaîne opératoire'* approach and various recent refitting projects (*e.g.,* Schlanger 1995a; Marks and Volkman 1983; Goring-Morris *et al*. 1998).

The interaction between typology and technology

It is redundant today to speak about the frequencies of blade/let tools amongst the tool assemblages and blade/lets in the debitage, initially the primary criteria for differentiating between the 'Ahmarian' and 'Levantine Aurignacian' traditions. There is currently a much greater awareness of the interdependence between typology and technology. Consideration must be made of the reduction sequences involved in the production of blanks, and their modification into tools:

> 'Concerning lithic analysis in general, I wonder if it is fully appreciated that advances in lithic technology, as against developments in typology, do not always occur synchronously through time. In a hypothetical sequence, one aspect (*e.g.*, the typology) seen in level 1 will change in level 2 above, while the technology remains the same as that in level 1. By level 3 the laggard aspect will catch up. Interpretation of this will thus be affected by the orientation of the analyst. Many examples can be cited....' (Copeland 1997:189).

The problem of 'fossiles directeurs', *'cultural markers' and the 'lazy' nature of Levantine knappers*

Besides clearly Mousterian forms that were retained unto the early Upper Palaeolithic, and the carinated artefacts that are problematic in their own right (Belfer-Cohen and Grosman in press and references therein), probably the most typical tool of the Upper Palaeolithic repertoire is the point. The various point types (Emireh, el-Wad, Ksar Akil, Umm el-Tlel points, through to the finely retouched bladelets of terminal Upper Palaeolithic industries – the so-called 'Ouchtata' points) illustrate the interplay of typology and technology. The Emireh and Umm el-Tlel points derive from Levallois blanks, while the others derive from various and different blade/let techniques of blank production. Yet, in many respects they all derive from a 'Levallois' (*sensu* Bordes 1961a) predetermined mindset, in that the basic shapes of all these points are predicated on the blank rather than on subsequent retouch (Belfer-Cohen and Goring-Morris in press). For sure this has something to do with the fact that all of the Levantine Upper Palaeolithic point types ultimately reflect a simple morphotype. Perhaps it befits the traditional 'lazy' Levantine spirit, since all these artefacts represent minimal investment of effort. Consider the ubiquitous Middle Palaeolithic Levallois points in the Levant (and the scarcity of Mousterian points, be the reason as may be – see Bar-Yosef 2000 for an overview). This tradition of minimal retouch to a generalized predetermined blank morphotype is indeed a Levantine characteristic that transcends the various lithic entities throughout the Middle Palaeolithic and the entire Upper Palaeolithic.

The problem of el-Wad points is further complicated by the fact that they were initially markers of the Levantine Aurignacian and only later of the Ahmarian (and see above). Indeed the el-Wad point *grosso modo* is found in virtually every Upper Palaeolithic assemblage, admittedly in varying frequencies. It is fascinating to note Dorothy Garrod's observations from long ago: '… the small, sharp Font-Yves point, which is the special feature of Upper Palaeolithic III [the Levantine Aurignacian of today], is hardly known in the West.' (Garrod 1953:25). Furthermore: '… the Upper Palaeolithic III represents the stage at which an incoming Aurignacian group made contact with the natives, adopting and developing the Font-Yves point, which was missing from their original tool-kit, and which in any case rather soon went out of fashion again' (*ibid*.:33).

The use of *fossiles directeurs* fell out favour during the 1950's through to the 1980's, challenged by the quantitative approach (*e.g.*, Stekelis 1954, 1961). Yet, specific and distinctive tool types do seem to be characteristic of particular chrono-cultural horizons during the Upper Palaeolithic in the Near East. Examples include the Emireh point, chamfered pieces, and the Ksar Akil scraper (Marks and Kaufman 1983; Azoury 1986; Besançon *et al*. 1975–1977; Copeland 1982; Coinman 2000; Jones *et al*. 1983).

The Middle to Upper Palaeolithic Transition

What, ultimately, is the specific importance of the Levantine Upper Palaeolithic? The Middle to Upper Palaeolithic transformation seems to occur earlier here than elsewhere in Eurasia. Is it simply another 'out of Africa' phenomenon (McBrearty and Brooks 2000)? If so, in contrast to earlier waves from Africa, here there was now an element of choice between Middle and Upper Palaeolithic lifeways. On the other hand is it possible that the transition in the Levant (as opposed to that in Europe) actually hardly involved any really meaningful change in and of itself? Certainly the nature of the transition in the Levant was quite different from the processes documented in Europe. The initial Levantine Upper Palaeolithic hardly differs in material culture terms from the local Middle Palaeolithic. It could, perhaps, be argued that it is only with the appearance of the Levantine Aurignacian that the transition is completed in the Near East.

Indeed, was there a single transition or multiple transitions? What does Boker Tachtit represent – simply a local sequence running directly from the Middle Palaeolithic through a transitional stage to the early Upper Palaeolithic? A transitional phase topped by a full-fledged, though early Upper Palaeolithic? Or, perhaps it is just a local sequence of early Upper Palaeolithic throughout (Marks and Volkman 1983; Marks 1993, Bar-Yosef and Kuhn 1999; Bar-Yosef 2000 and references therein)? How does Boker Tachtit relate to the other transitional stages recognized at Ksar Akil (Bergman 1987a; Ohnuma 1988; Ohnuma and Bergman 1990;

Azoury 1986)? How has one to treat the material from Umm el-Tlel (Ploux 1999; Bourgignon 1996, 1998; Molist and Cauvin 1990) – what is the so-called '*Mousterien tardif*'? Should the nature of Emireh (Neuville 1934) be reconsidered? What are we to make of some of the enigmatic finds from southern Jordan (Coinman and Henry 1995; Coinman 1997a, 1998a, 2000)? Finally, if indeed the Middle to Upper Palaeolithic transition occurred elsewhere, who or what (people or ideas) made it into the Levant and which route was taken? (Bar-Yosef 2000; Van Peer 1998).

Upper Palaeolithic Origins and External Connections

The issue of connections, if any, with other regions, near and far, remains contentious and open to debate. In the past there was a tendency to view Levantine Upper Palaeolithic developments as local (except for the Aurignacian). However, more recently, many of its features are considered to derive from elsewhere (for example the Libyan site of Haua Fteah, with its chamfered pieces – McBurney 1967). Indeed scholars are searching for signs of a global 'Upper Palaeolithic Revolution'. Thus, while some claim that the Ahmarian, as opposed to the 'Classic' Levantine Aurignacian, is endemic to the Levant (Marks 1990), others state the opposite, that it was brought over to the Levant by Cro-Magnon populations migrating out of Africa (*e.g.,* Bar-Yosef 2000*).*

Undoubtedly, discoveries during the last decade or so of occurrences in regions, previously viewed as largely devoid of Upper Palaeolithic remains, need to be reconsidered – whether in southern Turkey (*i.e.* Karain, Okuzini), Iran/Iraq (the so-called 'Zagros Aurignacian' – previously called Baradostian), Georgia, and Greece (Otte *et al.* 1998; Olszewski 1999; Bailey 1997, Bailey *et al.* 1999; Galanidou 1997; Koumouzelis *et al*. 2001; Mesheviliani *et al.* in press). In contrast to the past, when inter-regional comparisons focused primarily upon developments within central/western Europe, now we need to take into consideration a more complex global view of relationships.

Most researchers agree that the Levantine Aurignacian, which appears relatively late (*ca*. 32k bp) in the local Upper Palaeolithic record was brought over from Europe. Nevertheless, some scholars (*e.g.,* Otte in Djindjan *et al*. 1999) still seek the origins of the Aurignacian not in eastern Asia (the previously accepted source), but further north, in the Caucasus. Others believe that early Aurignacian assemblages developed out of the Levantine Ahmarian *en route* to Europe, carried over by the 'invading' Cro-Magnons (Bar-Yosef 2000). This is undoubtedly an interesting hypothesis that needs further testing. Put another way, this would indicate that a wave coming through the Levant brought about the changes in Europe that ultimately fostered the Aurignacian and that the Levantine Aurignacian portrays the return of the descendants – as 'newcomers to old and familiar territories' (Bar-Yosef 1998:166).

Reconstructing Upper Palaeolithic Lifeways in the Levant

There are still many more issues to be addressed pertaining to the body of the Upper Palaeolithic phenomenon *per se*: For example, how can we correlate the changes observed during the Upper Palaeolithic (as reflected in the lithic components) with other aspects of human behaviour? Unfortunately, the evidence is extremely meagre: there are virtually no human remains and burials, poor faunal assemblages, and few artistic manifestations. An especially positive development is the provision of new data as regards the climate of the period (Bar-Matthews *et al*. 1999 and see herein).

Yet, the contrast with the western European Upper Palaeolithic, where exciting new phenomena continue to be documented, pushing back the early manifestations of sophisticated parietal art (*e.g.,* Valladas 2001), is stark.

Some of the lithic changes between the Middle and Upper Palaeolithic in the Levant likely derive from technological innovations, such as different hafting techniques and the emergence of more distinct functional/typological tool classes (Shea 1988; Bergman and Newcomer 1983; Bergman 1987b; Peterkin 1993; Peterkin *et al*. 1993; Belfer-Cohen and Goring-Morris 2002).

As yet we remain with more questions than answers concerning the interrelationships and interactions between the various entities populating the Levantine Upper Palaeolithic. Are we dealing with real cultural entities (as seems to be the case)? For example, even if the Ahmarian and Aurignacian are absolutely contemporary within the Levant as a whole, does this entail contemporaneity *within* any specific region of the Levant? The Ahmarian has an extensive distribution throughout the region, while the Levantine Aurignacian is seemingly restricted to the Mediterranean coastal zone (Figs. 1.2–1.3). The notion of a unilinear development from the Ahmarian to the Aurignacian has indeed been dropped, but what are the inter-relationships among all the various entities that we have outlined above? How strong is the evidence for direct continuity and evolution from the Early Ahmarian into the Late Ahmarian/Masraqan? What is the nature of the relationships between the Levantine Aurignacian and the Atlitian flake-based assemblages? And how should we interpret the unnamed flake assemblages in the Negev?

The Upper to Epipalaeolithic Transition

Three decades have passed since the industries included within Upper Palaeolithic phase VI were set aside and incorporated within the Epipalaeolithic period (Neuville 1934; Perrot 1968; Bar-Yosef 1970; Bar-Yosef and Vogel 1987; Goring-Morris 1987; Henry 1989a). Subsequently

the term ‘Kebaran’ became synonymous with the early Epipalaeolithic, in many respects itself an umbrella term incorporating a wide range of industries. Yet, the Upper Palaeolithic to Epipalaeolithic interface remains contentious (Gilead 1983, 1984), as the criteria used to differentiate between them has evolved in the meantime. The quantitative proportions of microliths within assemblages are no longer considered to be significant, in and of themselves, as cultural markers, but rather it is the tempo and nature of change, with the microliths’ stylistic attributes that we believe reflect increasing territoriality throughout the region. Certainly, during the period from *ca*. 22,000–14,500 bp the lithic assemblages display varying combinations of Upper Palaeolithic and Epipalaeolithic technological and typological features (Belfer-Cohen and Goring-Morris 2002).

Summing up the beginning

Unfortunately, in the present state of Upper Palaeolithic Near Eastern research the vast majority of the available data relates to lithics. Thus, if we want to try and reconstruct behavioural processes and patterns we have to squeeze meaning from these stones beyond that relating to lithic typology and technology. Being aware of the magnitude of the task at hand, we will settle for the hope that prehistoric research as such has fulfilled the promises of providing at least some answers related to the issues enumerated above. We do believe that the sharing and exchange of information (data and interpretation, theory and facts) among the research community studying the Levantine Upper Palaeolithic will provide some impetus to the understanding of the human past in this particular region of the world at large.

2. Climatic Conditions in the Eastern Mediterranean During the Last Glacial (60–10 ky) and Their Relations to the Upper Palaeolithic in the Levant as inferred from Oxygen and Carbon Isotope Systematics of Cave Deposits

Miryam Bar-Matthews and Avner Ayalon

Introduction

The time interval from 60 to 10 ky defines the last cold stage (Martinson *et al.* 1987) when Earth experienced a wide spectrum of environmental conditions, *i.e.*, episodes of warm and cold periods (interglacial-glacial) as well as a number of short-lived climatic oscillations ('stadials' and 'interstadials'). The information on climatic conditions is gained from: detailed cores from the Greenland and Antarctic ice sheets; deep sea sediments; lake sediments; pollen and studies of cave deposits (speleothems) (*e.g.*, Shackleton 1969; Gascoyne 1983; Imbrie *et al*. 1984; Barnola *et al.* 1987; Heinrich 1988; Bond *et al.* 1992; Dansgaard *et al*. 1993; Jouzel *et al.* 1993; Rossignol-Strick 1995). Data from all these sources form the basis for the reconstruction of palaeoclimatic conditions.

The oxygen isotopic record from deep-sea sediments serves as a climate proxy and essentially reflects changes in temperature and global ice volume. The isotopic signal suggests that the last glacial was divided into three marine isotopic stages (Stages 4, 3 and 2). During Marine Isotopic Stage 4 and especially during Stage 2, a major increase in ice volume occurred. The marine isotopic record implies that the sea level rose from below -75 m to - 50 m between Stages 4 and 3, followed by an overall sea level decrease to -120 m during Stage 2 (Shackleton 1987). Many of the more recent studies indicate a greater degree of variability (*e.g.* Bond *et al.* 1993) pointing to significant environmental changes on a much shorter time scale. These Dansgaard-Oeschger cycles are warming-cooling events with durations of 500 to 2,000 years, and episodes of ice rafting, such as the Heinrich events (Heinrich 1988).

The above time-period coincides also with the transition from the Middle to Upper Palaeolithic in the eastern Mediterranean and is roughly contemporary with the Upper Palaeolithic in the Near East. Thus, the reconstruction of climatic events becomes also the study of how environmental changes may have affected human adaptations in the region. In the Levant, the Upper Palaeolithic sequence began *ca*. 47–45,000 bp with the Emiran (and other transitional industries), followed by the blade/let industries of the Ahmarian Complex. Subsequently, *ca*. 34–27,000 bp, an intrusion of Levantine Aurignacian is documented within a limited geographical area of the central Levant. By *ca*. 19,000 bp, Epipalaeolithic microlithic industries appeared, *e.g*. the Kebaran Complex (Bar-Yosef 2000).

Cave Deposits (Speleothems) as Palaeoclimatic Indicators

Stable oxygen ($\delta^{18}O$) and carbon ($\delta^{13}C$) profiles of speleothem calcite have been the most thoroughly investigated climate proxies (*e.g.* Hendy 1971; Thompson *et al.* 1974; Harmon *et al.* 1978; Schwarcz 1986; Gascoyne 1992). The $\delta^{18}O$ values of speleothems depend on the isotopic composition of the water from which they were deposited and the temperature of formation. The relationships between the $\delta^{18}O$ of the calcite, of the water from which the calcite was deposited and the temperature of formation was formulated by O'Neil and others (1969). To resolve the calcite-water fractionation equation two variables have to be determined: the past temperature and the past isotopic composition of the water. Without independent data it is impossible to differentiate between the effects of these two variables. Information on one of these variables can be gained from the isotopic composition of past waters that were trapped as fluid inclusions in the

speleothems' calcite (*e.g.*, Harmon *et al.* 1979; Schwarcz and Yonge 1983; Matthews *et al.* 2000). However, this method is still problematic and our information on either the past water isotopic composition or on the palaeotemperatures is usually derived from other independent proxies.

The carbon ($\delta^{13}C$) values reflect changes in the vegetation type in the vicinity of the cave. Relative proportions of Mediterranean-type vegetation (C3-type, trees, shrubs and some grasses) and vegetation that is typical for colder, or arid conditions (C4-type, temperate grasses) can be gained from the $\delta^{13}C$ values of the calcite speleothems. Because these two types of vegetation have distinct photosynthetic pathways, they each have a distinct isotopic signature. Water percolating through the soil above the cave carries the information relating to the C3 and C4-type vegetation. Enrichment in the ^{13}C of the speleothems' calcite usually reflects an increase in the contribution of C4 plants to the soil CO_2 (*e.g.*, Cerling *et al.* 1991; Cerling and Quade 1993; Bar-Matthews *et al.* 1997a, b; Dorale *et al.* 1998).

One of the major advantages of speleothem studies is the ability to accurately date them using the mass-spectrometric (TIMS) ^{230}Th-U method, which is the most reliable and precise Quaternary dating technique. ^{230}Th-U ages are considered to be very accurate since they accord with those from dendrochronology. The ^{14}C dating method is not a totally accurate chronometer as the atmospheric $^{14}C/C$ level has changed with time (Bard *et al.* 1990). Between 20 and 32 ky, ^{14}C ages are ~2.5±0.5 ky younger than the calendar ages. Between 32 and 39 ky ^{14}C ages are younger by ~3±1 ky and at 40 ky the difference is ~4–5 ky (Schramm *et al.* 2000).

In this paper we present a continuous $\delta^{18}O$ and $\delta^{13}C$ profile of speleothems from the Soreq Cave, Israel, for the time period of 60 to 10 ky. The isotopic record will be discussed in the context of changes in temperature and rainfall amounts. The cave is located on the western flanks of the Judean Hills (Fig. 2.1) and was described by Even *et al.* (1986) and Bar-Matthews *et al.* (1991, 1997a, b). Though located in what is presently a semi-arid region (receiving about 500 mm annual rainfall), Soreq Cave is especially suited to palaeoclimatic studies. This is because the cave is located in a narrow transition zone, between a humid region to the north (where annual rainfall reaches 2,000 mm, in the Anti-Lebanon Mountains, 200 km away) and an arid region to the south (where annual rainfall drops below 100 mm, in the southern Negev Desert, 150 km away). Thus, relatively minor spatial shifts in environmental parameters can cause major climatic perturbations in the vicinity of the cave by displacing the desert boundary either northward or southward. These displacements may result from changes in temperature, rainfall rate, effective precipitation (*i.e.*, evaporation to precipitation ratio) and storage capacity of the local (carbonate) aquifer.

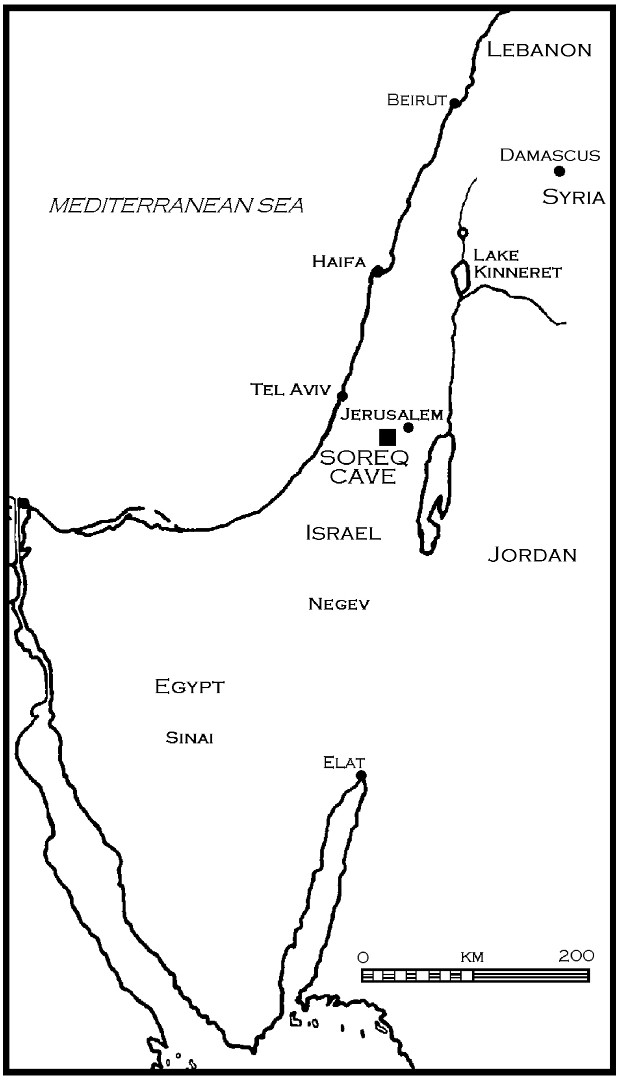

Fig. 2.1 Location map of Soreq Cave. The cave is located approximately 40 km inland east of the Mediterranean Sea, 20 km southwest of Jerusalem and 400 m above sea level.

Methods

$\delta^{18}O$ and $\delta^{13}C$ values for *ca.*1500 measurements were obtained from 20 different stalagmites and stalactites, *ca.* 60–250 mm in diametre, from various locations within the cave. Sample preparation and experimental procedures are described in detail by Bar-Matthews and others (1997a, b). The speleothems were sectioned perpendicularly and/or along their length, in order to expose the growth layers. Samples were obtained by drilling 0.2–0.5 mg calcite powders every 0.5–1.0 mm throughout the sectioned speleothem. Sampling in such detail was required in order to obtain an isotopic profile of sufficient resolution. The drilled powder was analyzed for $\delta^{18}O$ and

$\delta^{13}C$ using a VG Isocarb system attached to a SIRA-II mass-spectrometer, as described in detail by Bar-Matthews and others (1997a, b). All $\delta^{18}O$ and $\delta^{13}C$ values were calibrated against the international standard NBS-19, and are reported in permil (‰), relative to the Vienna PeeDee Belemnite (VPDB) standard.

For the ^{230}Th-U dating, a series of fine laminae about 1.0 cm thick were separated from each other. Age determinations were performed on 18 speleothems by means of standard alpha spectrometric measurements and by Thermal Ionization Mass Spectrometry (TIMS) following the procedure described by Bar-Matthews and others (1997a, b) and Kaufman and others (1998). None of the studied speleothems covered the entire age interval of 50 ky. In order to obtain a continuous record we compared the $\delta^{18}O$ and $\delta^{13}C$ profiles of several speleothems covering similar time intervals and found excellent matches, which enabled us to extend the isotopic record by matching the oldest laminae of a younger speleothem with the youngest laminae of an older speleothem.

Results and Discussion

The $\delta^{18}O$ and $\delta^{13}C$ values of speleothems that formed between 60–10 ky are shown in Figs. 2.2 and 2.3. In order to determine how to relate the isotopic changes to temperature and rainfall amount we used our knowledge of present-day conditions. This includes the present-day relationships between the temperature of speleothems' deposition and their isotopic composition; the isotopic composition of rain and cave waters; the relationships between the rainfall amount and its isotopic composition and the average temperature of the vapour source, *i.e.*, the eastern Mediterranean Sea (Bar-Matthews *et al*. 1996, 1997a, b, 1998, 1999, 2000a, b; Ayalon *et al*. 1998, 1999; Matthews *et al*. 2000). These studies demonstrated that lower $\delta^{18}O$ values are associated with a relative increase in both temperature and hydrological activities in the area, whereas higher $\delta^{18}O$ values are associated with colder temperatures and less rainfall. However, although the rainfall amount decreased, the effective precipitation increased. The effective precipitation is determined by the precipitation to evaporation ratios, causing water to be retained in the unsaturated zone during less rainy, but cooler, glacial times.

The general trends of changes in $\delta^{13}C$ follows the $\delta^{18}O$ trend (Fig. 2.2). Because the $\delta^{13}C$ values are climatically controlled, any changes in the temperatures and rainfall amount affected also the vegetation cover. Lower $\delta^{13}C$ values, usually ranging between *ca.* -13 and -10% , are associated with the dominance of C3-type vegetation. Higher values indicate an increased contribution of C4-type vegetation.

The $\delta^{18}O$ record of the Soreq Cave speleothems as evident from Fig. 2.3 shows several cycles, each lasting from a few hundred to several thousand years and labelled K to A:

Cycle K lasted from *ca*. 57.5–56.5 ky and displays $\delta^{18}O$ values from -4.5 to -3.2‰ .
Cycle J occurred from *ca.* 56.5–54.5 ky, with $\delta^{18}O$ values of -4.4 to -3.1‰ .
Cycle I, which is relatively long, continued for about 5,000 years, from *ca.* 54.5–49.5 ky, and had a high $\delta^{18}O$ amplitude, from -5.3 to -3.0‰ .
Cycle H lasted from *ca.* 49.5–46 ky, with $\delta^{18}O$ values varying from -4.2 to -2.5‰ .
Cycle G, which is the longest one under consideration, had a duration of 10,000 years, from 46–36 ky, and demonstrated only minor $\delta^{18}O$ fluctuations, ranging from -3.8 to -2.6‰ .
Cycle F was very short, lasting only about 1,000 years, from *ca*. 36–35 ky, but displaying a large $\delta^{18}O$ amplitude, from -4.4 to -2.3‰ .
Cycle E was also short, lasted also about 1,000 years, from *ca.* 35–34 ky, and had $\delta^{18}O$ values from -3.8 to -2.5‰

The following cycles D and C were rather long, with Cycle D lasting about 8,500 years, from 34–25.5 ky, with little $\delta^{18}O$ variations, ranging between -3.6 to -2.7‰ . Cycle C lasted from 25.5-18.5 ky with $\delta^{18}O$ values from -3.6 to -2.4‰ .

The shared characteristics of Cycles K, J, I, H, F and E display a trend from lower to higher $\delta^{18}O$ and $\delta^{13}C$ values, *i.e.* transitions from warmer and wetter to cooler and dryer climatic conditions. This type of oscillation is similar to the Dansgaard-Oeschger cycles. The longest and most pronounced cycles among them are I and H, each lasting about 4,000 years. The start of Cycle I *ca.* 54.5 ky, with very low $\delta^{18}O$ values, represents the warmest and wettest period during the last glacial. The end of Cycle H at *ca.* 46 ky coincides with very high $\delta^{18}O$ values, and was one of four short episodes of very high $\delta^{18}O$ events, representing very dry and cold periods during the last glacial. Cycle G, with stable and high $\delta^{18}O$ values around -3‰ , represents about 10,000 cold years. The most drastic climatic changes occurred over the shortest cycles, F and E, which are both characterized by a very short rise and then an immediate drop in $\delta^{18}O$ and $\delta^{13}C$ values. Cold conditions prevailed until the end of Cycle C, which ended at *ca.* 19 ky, the time equivalent to the last glacial maximum (LGM).

Cycle B occurred during the period of deglaciation, from 18.5–14 ky, when climatic conditions became much wetter and warmer. The $\delta^{18}O$ values dropped sharply from -2.5 to -6‰ .

Cycle A represents a cold and dry event during the deglaciation, most probably known as the Younger Dryas (YD), which occurred between *ca.* 13.1–11 ky. $\delta^{18}O$ values increased from -6 to -4‰ and returned to -6‰ at the end of the event. The general isotopic pattern of the last glacial is that the earlier part, until 34 ky, was warmer than the later part, from 34–19 ky.

Today, there is a strong similarity between the average

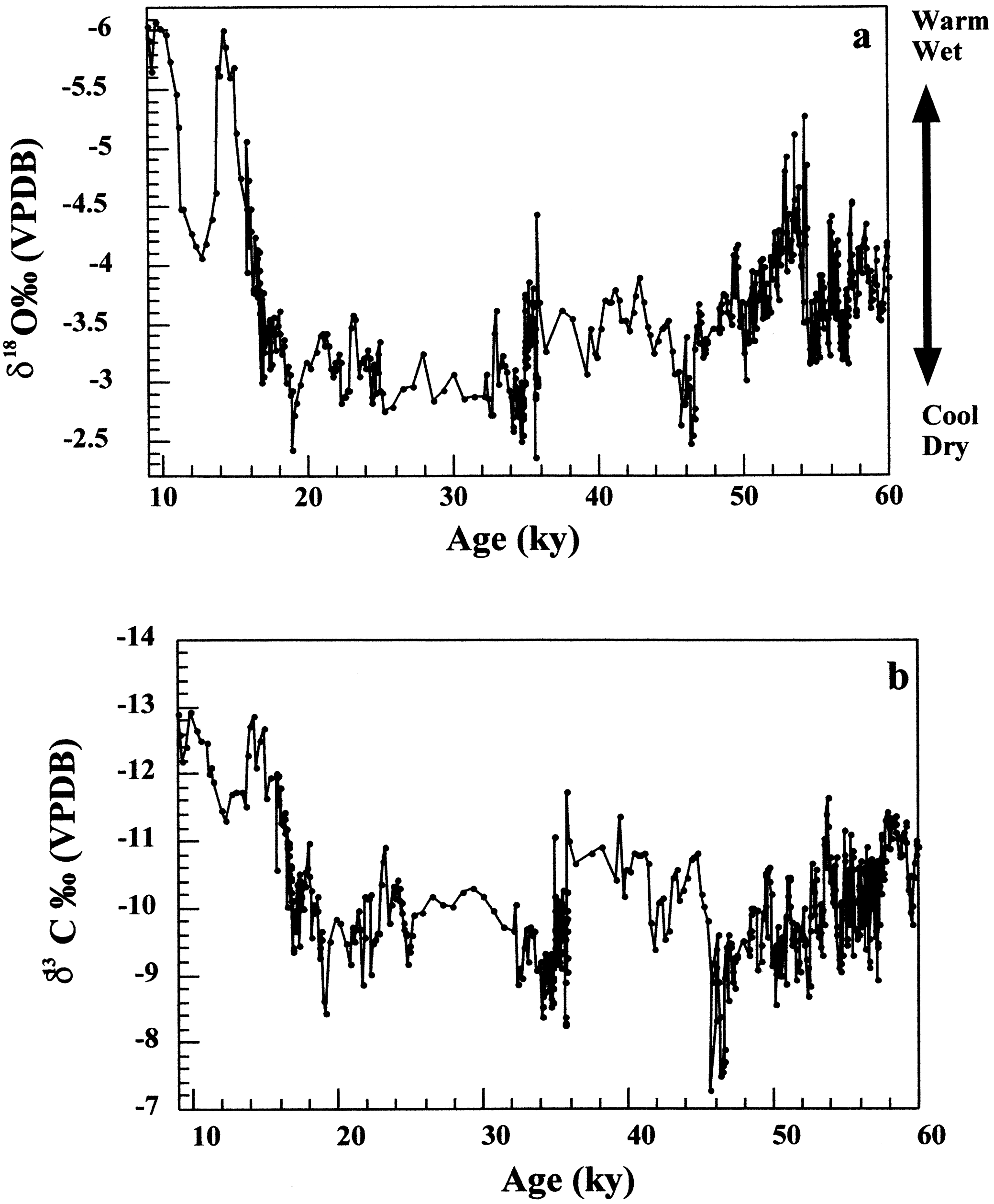

Fig. 2.2 $\delta^{18}O$ (a) and $\delta^{13}C$ (b) variations of the Soreq Cave speleothems back to 60 ky. On the right axis of the diagram (a) a vertical bar marks the trends towards dry-cold and wet-warm climate.

eastern Mediterranean Sea Surface Temperatures (SST) during the winter months (when rainfall and the major supply of water into the Soreq Cave occur) and the temperature of speleothem deposition (*ca.*19°C). We assume that the same similarity existed in the past. The eastern Mediterranean SST have been determined for major episodes during the last 60 ky using various methods (Emeis *et al.* 1998, 2000; Kallel *et al.* 1997, 2000). They estimated that during the beginning of Cycle I, at *ca.* 54 ky, the SST was rather warm at *ca.* 17°C. For the Younger Dryas they estimated a temperature of 12°C, and even colder temperatures are estimated for the coldest events at 46, 36, 34 and 19 ky.

Based on these temperatures, we have calculated the isotopic composition of the water from which the speleothems were deposited using O'Neil and others (1969). From the isotopic composition of the water, we also calculated the palaeo-annual rainfall amount (Fig. 2.4). These calculations were based on the assumption that the present-day relationships between the isotopic composition of the rain – *i.e.*, cave water – and the amount of rainfall were the same in the past. For the rainfall

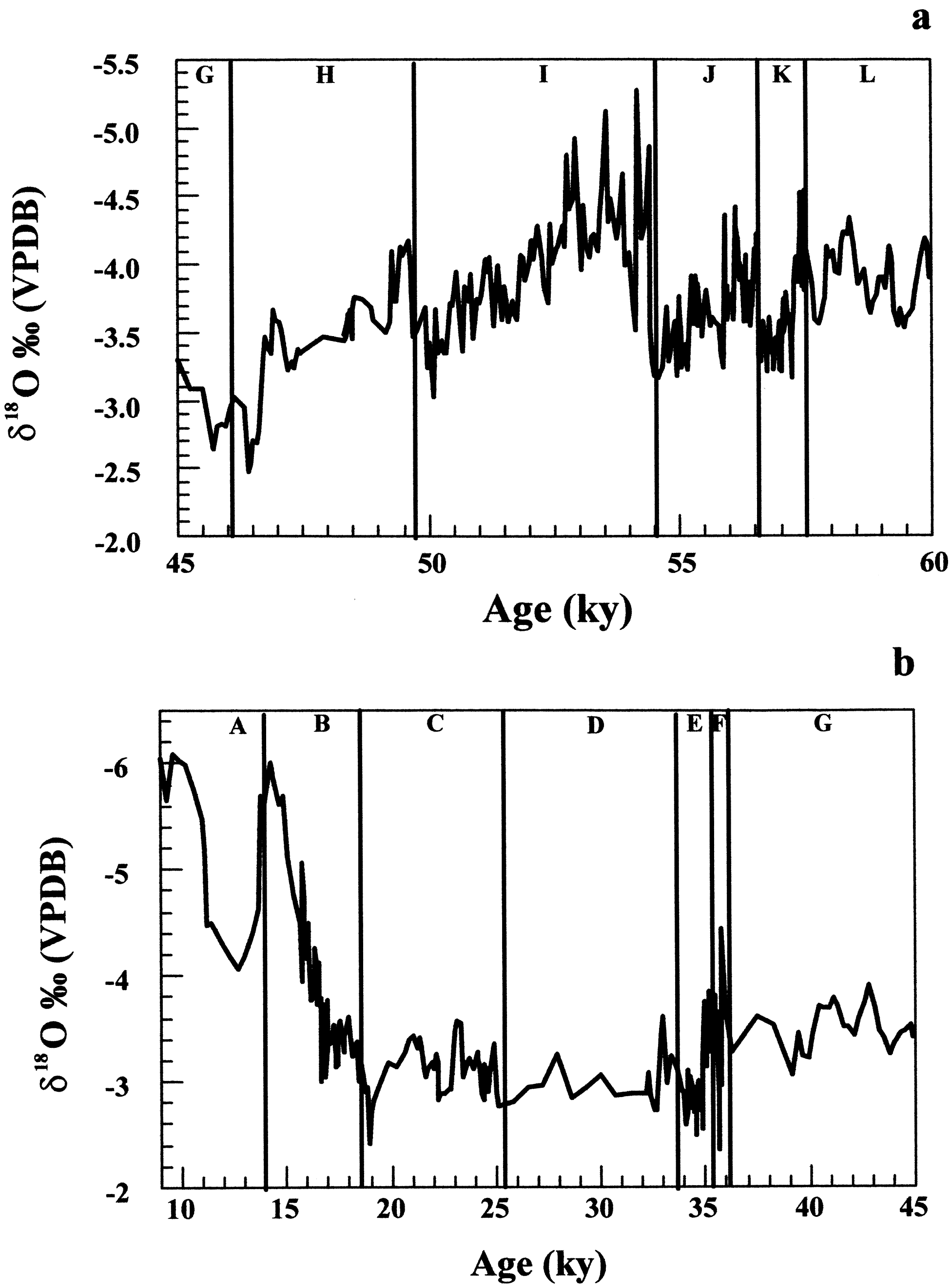

Fig. 2.3 A close-up of the $\delta^{18}O$ variations of Soreq Cave speleothems from 60 to 45 ky (a) and from 45 to 10 ky (b). The isotopic cycles are marked from K to A, and are indicated by vertical lines.

amount calculations we estimated the temperatures based on the general trends of the $\delta^{18}O$ values for the time intervals for which the SST were not calculated by previous studies. The present-day relationships indicate that a change of about 1‰ in the $\delta^{18}O$ of the rainwater is more or less equivalent to 200 mm of annual rainfall (Bar-Matthews *et al.* 1996, 2000b; Ayalon *et al.* 1998). Thus, the maximum drop of $\delta^{18}O$ observed in the speleothems during the last glacial (Figs. 2.2–2.3), from about -5‰ to about -2.5‰, is equivalent to a *ca.* 50% drop in the annual amount of rainfall. During the deglaciation the decrease in $\delta^{18}O$ of about 3‰(from about -2.5 to -6‰) is equivalent to an increase of about 300 mm (Fig. 2.4).

Many of the climate events recorded in the Soreq Cave speleothems were also recorded in the north Atlantic, particularly some of the cold events, known as Heinrich events, the last glacial maximum, the Younger Dryas, the deglaciation and the Dansgaard-Oeschger cycles. Where-

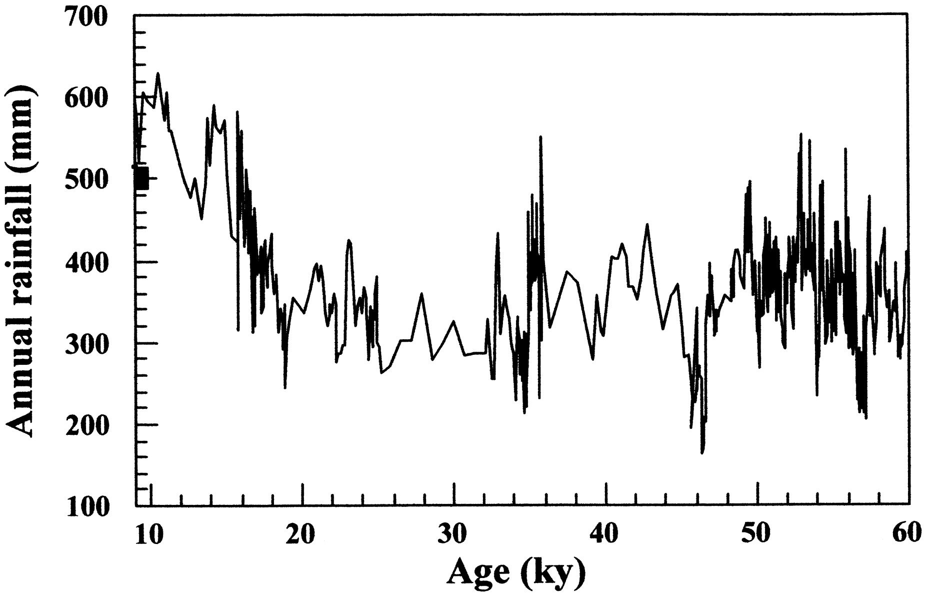

Fig. 2.4 Calculated amount of annual rainfall (mm) based on the $\delta^{18}O$ of the Soreq Cave speleothems (for explanation see text). The rectangle on the left axis represents the present-day average annual rainfall.

as in northern Europe during a large part of the last glacial freezing conditions would have prevailed, in the eastern Mediterranean region the continuous deposition of speleothems indicates that the climate was much milder. The feedback between the north Atlantic, the Mediterranean Sea and the nearby landmasses, is expressed by the changes in temperatures and the isotopic composition of the rainfall. Although there are many studies on the past climate of the eastern Mediterranean area and northern Africa, none of them were done with the same chronological resolution. Nevertheless, from various studies it is clear that other proxies also record the major cold-dry and wet-warm events recorded by the Soreq Cave speleothems. The other proxies include: soil developments in the present-day arid area of the Negev desert; terrace development and erosion processes; dune incursions; the isotopic composition of carbonate nodules and land snails; lake deposits; and deep sea sediments (*e.g.*, Magaritz and Kaufman 1983; Goodfriend and Magaritz 1988; Goring-Morris and Goldberg 1991; Almogi-Labin *et al.* 1986; Magaritz 1986; Magaritz and Goodfriend 1987; Goldberg 1995; Rossignol-Strick 1995; Frumkin *et al.* 1999; Goodfriend 1999).

Summary

The continental palaeoclimate of the last glacial (about 60 to 10 ky) in the eastern Mediterranean region was determined by a high resolution study of the oxygen and carbon isotopic composition of cave deposits (speleothems) from the Soreq Cave, Israel, with chronology provided by precise ^{230}Th-U mass spectrometry ages. This time interval coincides also with the evolution of modern humans and is roughly parallel with the Upper Palaeolithic period in the Levant. The entire period from 60 to 19 ky shows a general cooling trend from about 17 to about 10°C and annual rainfall from about 200 to 550 mm. On top of the general trend there are several climatic cycles lasting a few hundred to several thousand years similar to the Dansgaard-Oeschger cycles. The wettest and the warmest events during the last glacial occurred at 54 to 52 ky and at 36 ky. Four short very cold events occurred at 46, 35.5, 34.5 and 19 ky. Sharp warming and increased precipitation characterized the deglaciation period from 19 to 10 ky which was interrupted by another cold event, probably equivalent to the Younger Dryas (YD) from about 13.5 to 11 ky.

Climatic events recorded in the Soreq Cave were also displayed in the north Atlantic, including some of the cold Heinrich events, the last glacial maximum, the Younger Dryas, the deglaciation, and the Dansgaard-Oeschger cycles. But, whereas in northern Europe during much of the last glacial freezing conditions prevailed, in the eastern Mediterranean region the uninterrupted deposition of speleothems indicates that the climate was much milder.

3. Some Observations on Middle and Upper Palaeolithic Ashy Cave and Rockshelter Deposits in the Near East

Paul Goldberg

Introduction

Caves and rockshelters, particularly in the Mediterranean zone, are increasingly recognized as possessing the capability of registering detailed and faithful sedimentary records originating from human, biological and geological inputs (Woodward and Goldberg 2001; Karkansas *et al*. 1999; Goldberg and Bar-Yosef 1998; Macphail and Goldberg 2000). Yet, stratigraphic details of these depositional sequences and their significance have only recently been studied in detail (Woodward and Goldberg 2001). Moreover, the issue of the evolution of human behaviour and how it is expressed in the archaeological record is still controversial. Nevertheless, increased archaeological and geological evidence appears to elucidate the linkage (or lack thereof) between behaviour, time and cultural entity (*e.g.*, Bar-Yosef and Kuhn 1999; McBrearty and Brooks 2000; Klein 1995a; Meignen 1998a, 2000). Finally, it has been increasingly demonstrated that archaeo-sediments can and should be considered as artefacts that represent the manifestations of human behaviour (Goldberg 1999). The aim of this paper is to offer an eclectic view of some of the salient aspects of the anthropogenic deposits from two recently excavated cave/rockshelter sites in the Near East. These are used to illustrate the types of accessible information and how they may be interpreted in terms of human behaviour and palaeoenvironments.

The sites

Time and space restrictions preclude a detailed and extensive summary of the most important sites in the region. For this reason, I have chosen two sites – Kebara Cave, Israel, and Üçağızlı Cave, Turkey – which are currently being excavated or have been recently excavated with detailed documentation of context.

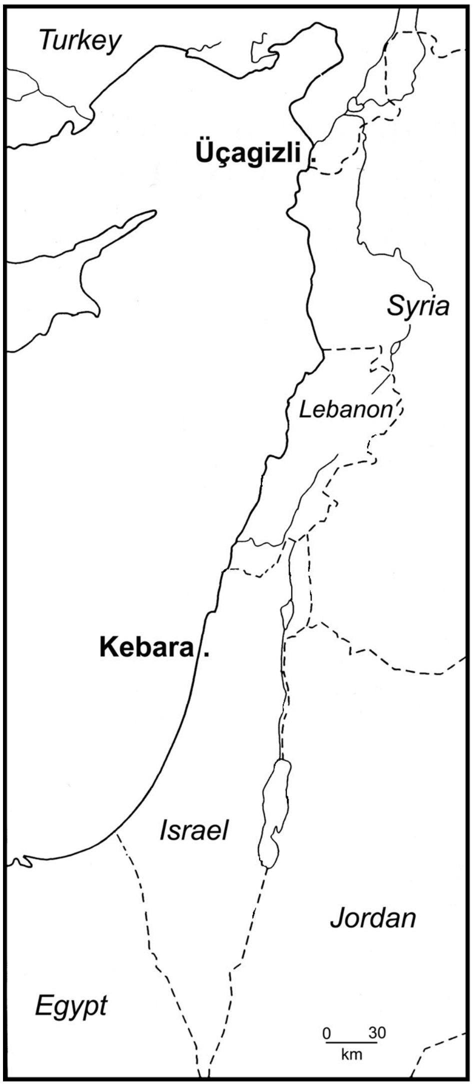

Fig. 3.1 Map showing location of Kebara Cave and Üçağızlı Cave.

Kebara Cave, Israel

Kebara Cave is located along the western slope of Mt. Carmel, about 30 km south of Haifa, at an elevation of *ca*. 60 m asl (Fig. 3.1) (Bar-Yosef *et al*. 1992, 1996; Laville and Goldberg 1989; Goldberg and Bar-Yosef 1998; Valladas *et al*. 1987). Initial excavations by Turville-Petre (1932) and by Stekelis (Schick and Stekelis 1977) revealed deposits with Middle Palaeolithic, Upper Palaeolithic, and Epipalaeolithic (Kebaran and Natufian) implements.

In general, the sediments consist of geogenic and anthropogenic brown and reddish sandy silts with many superimposed organic-rich burnt layers in the Middle Palaeolithic levels (Laville and Goldberg 1989). Geological processes include:

1. deposition of basal sandy sediments associated with phreatic water flow;
2. in-washing of terra rosa soils and reworking of previous deposits from the entrance by sheet wash, especially during the Upper Palaeolithic when wetter conditions were prevalent (Goldberg and Laville 1991; Bar-Yosef *et al*. 1996);
3. sporadic inputs of aeolian silt and sand, the latter likely associated with Pleistocene aeolianites that occur just in front of the cave;
4. collapse of large limestone blocks from the cliff above the cave entrance during Upper Palaeolithic times (Goldberg and Bar-Yosef 1998);
5. repeated sinkhole activity and the subsequent collapse of sediments into these subsurface depressions.

Anthropogenic processes are striking and significant, as represented by numerous lenticular and tabular hearths, and other burnt and ashy features (Fig. 3.2). In general, such features are much more abundant in the Middle Palaeolithic layers and are relatively sparse in the Upper Palaeolithic deposits. Micromorphological study of the burnt and ash-rich layers demonstrates a complex variety of features related to burning activities (Meignen *et al*. 2001). These elements include *in situ* burning features in which the original structural elements of the hearth are preserved (Figs. 3.2 and 3.3): a reddened base, a charcoal-rich layer above it, and a capping of whitish ash (at Kebara, many of these calcareous ashes have been diagenetically altered into different types of phosphate minerals (*e.g*., Weiner *et al*. 1995; Schiegl *et al*. 1996).

Other ash-related features within the Middle Palaeolithic layers take on different appearances. For example, in the rear of the cave, close to a large accumulation of bones (the so-called 'kitchen area' in Bar-Yosef *et al*. 1992) is a *ca*. 75 cm thick accretion of weakly to massive bedded ashes that thin out laterally (Fig. 3.4). Micromorphological analysis shows that in fact this material is composed of bedded calcareous ash, bone, clay and clay aggregates, and relatively few dispersed fragments of charcoal (Fig. 3.5). The sheer concentration of the ashes, their bedded nature, their internal organization, and the lack of structural organization typical of *in situ* hearths (*cf*. Figs. 3.2 and 3.3) shows that this material accrued as a result of intentional dumping of ashes by the Neanderthal inhabitants of the cave. This accumulation appears to have been accompanied by reworking of very low energy

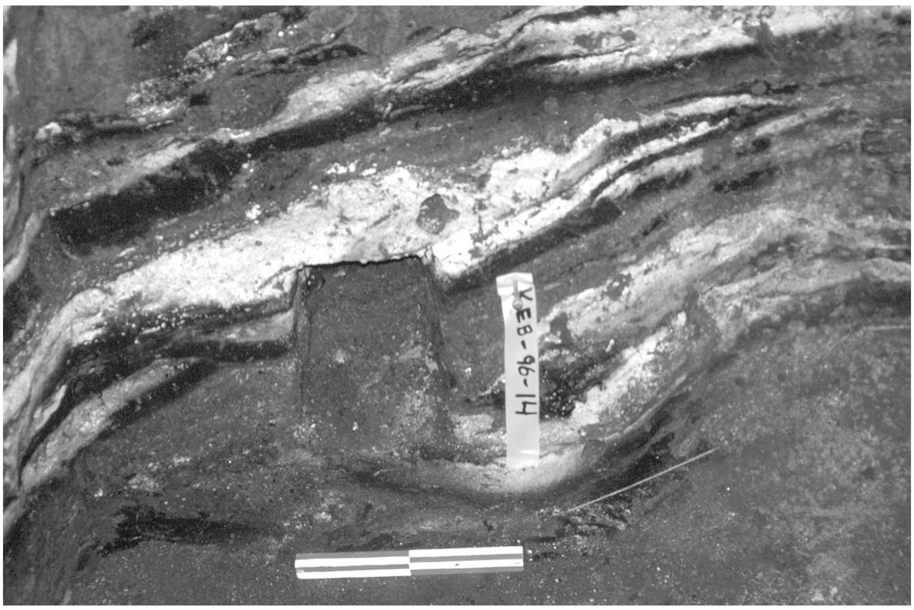

Fig. 3.2 Field photo of typical succession of hearths from the lower part of the Middle Palaeolithic succession at Kebara Cave (Layer XII).

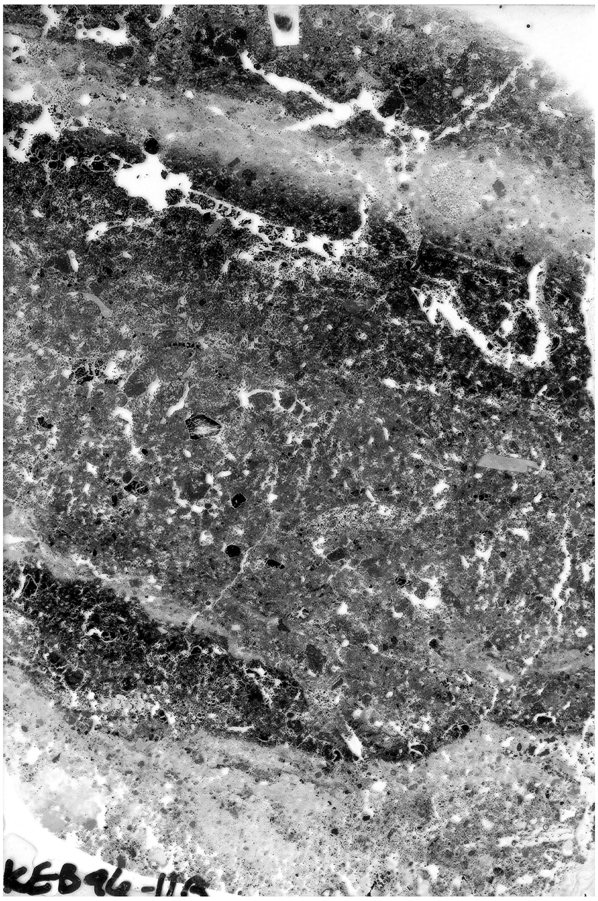

Fig. 3.3 Macrophotograph illustrating the micro-succession of hearths similar to those shown in Fig. 3.2 but on a smaller scale. Note the vertical structure (here repeated a few times) of the burnt features. Length of field = ca. *75 mm.*

flowing water localized along the walls at the rear of the cave. Results of other micromorphological work also indicate that many of the ashes and charcoal were redistributed after the burning event as a result of systematically cleaning-out hearths. This type of fastidiousness is not normally associated with typical Neanderthal behaviour.

Upper Palaeolithic hearths in Kebara are far less numerous and visible. This relative scarcity is likely due both to lower overall utilization of the cave during the Upper Palaeolithic and also to the nature of the deposits. Interior from the brow of the cave much of the Upper Palaeolithic deposits are characterised by finely laminated (and diagenetically altered) silts (Fig. 3.6), as well as previously deposited geogenic and anthropogenic sediments reworked from the entrance. The latter consist of both terra rosa originating from the exterior, but also dismantled Middle Palaeolithic hearth materials (Meignen *et al.* 2001).

The individual burnt layers overall tend to display similar structuring to those in the Middle Palaeolithic deposits (Fig. 3.2). One burnt layer from above those illustrated in Fig. 3.6 and now excavated, is *ca*. 5 cm thick, and consists of a brownish black base overlain by white ash; its upper part is truncated. In thin section (Figs. 3.7a and 3.7b), however, it looks different from those of the Middle Palaeolithic. For one, the charcoal is more splintered and numerous phytoliths are scattered throughout. This suggests that perhaps a different combustible was used in this fire (thin sections from other Upper Palaeolithic hearths in the cave show similar tendencies). In addition, they tend to be very porous, have fluffy or spongy fabrics, and are also generally organic rich, with little detrital quartz silt. The reasons for all these

Fig. 3.4 Large ca. *75 cm thick accumulation of ashes in Middle Palaeolithic layers from the rear of Kebara Cave, next to the so-called 'kitchen area.' Note the 4.5 inch trowel at the top for scale.*

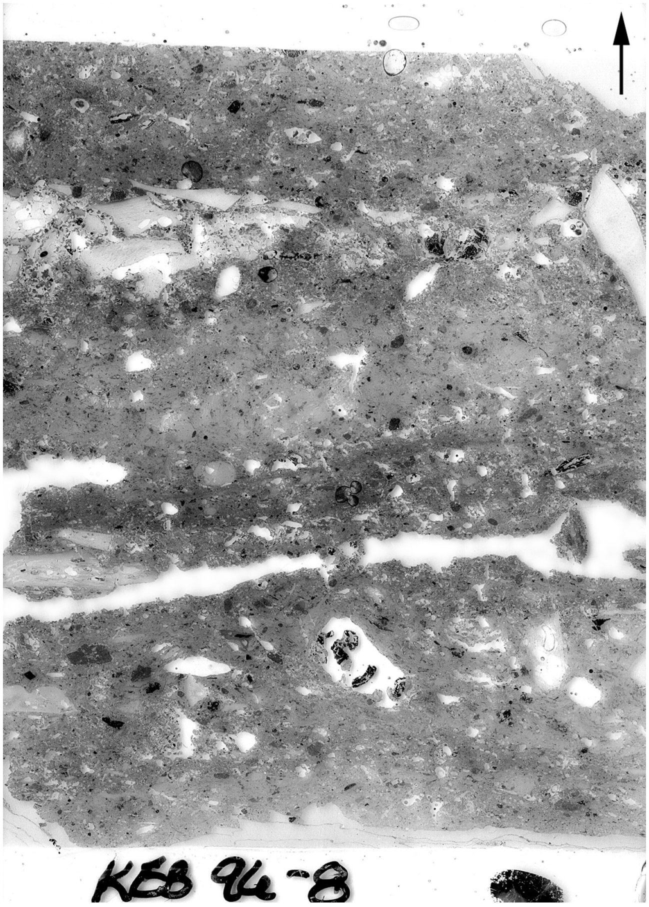

Fig. 3.5 Macrophotograph of sample 96–8 from ash accumulation in Fig. 3.4 (tagged sample on the right). Note the well-developed bedding of lighter ashes, bone fragments, and red clay aggregates, and the scatter of isolated grains of charcoal. All these features suggest that this was likely dumped ashy material, slightly reworked by dripping water or very low energy sheetwash. Length of field = ca. *65 mm.*

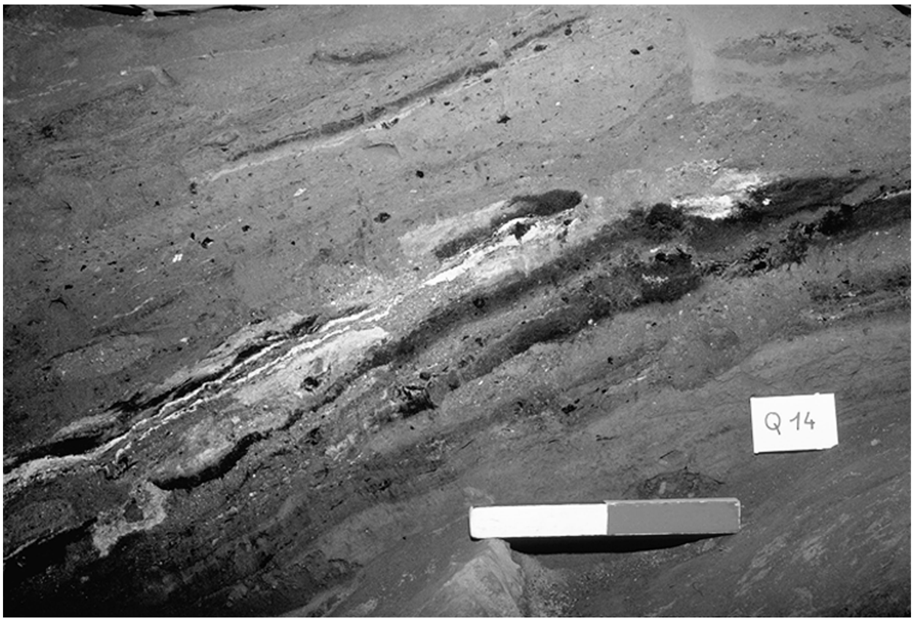

Fig. 3.6 Field view of Upper Palaeolithic burnt layers from Kebara Cave (photo courtesy of L. Meignen). Scale is 20 cm.

differences are not clear. Yet, it is reasonable to suggest that these Upper Palaeolithic burnt zones represent either a different type of combustible (grasses and brush rather than woody vegetation), or different burning conditions (*e.g*., lower temperatures), since field and diatom evidence indicate notably damp conditions within the cave during the Upper Palaeolithic. The influence of a damp substrate on the microstructure of hearths needs to be evaluated further.

Thus at Kebara, we see a different intensity in the use of fire between the Middle and Upper Palaeolithic. In addition, it seems that there is a difference in the types of combustible used between these two periods. Most interesting, however, is the behavioural pattern represented by the dumping of the ashes against the wall of the cave during the Middle Palaeolithic. This pattern appears to be complemented not with the Upper Palaeolithic deposits of Kebara but with those of the Upper Palaeolithic deposits at Üçağızlı Cave in Turkey discussed below.

Üçağızlı Cave, Turkey

Üçağızlı Cave is located in the Mediterranean coast of the Hatay region of southern Turkey in the extreme northeast corner of the Mediterranean basin (Fig. 3.1). Although the Hatay is part of the modern state of Turkey, it is more similar topographically and ecologically to the coastal Levant than it is to Anatolia.

The site itself is situated directly on the seacoast about 15 km south of the mouth of the Asi (Orontes) River (Fig. 3.1). The surface of the cave deposits lies at an elevation about 17 m above current sea level, *ca.* 1 m below a fossil (presumably Late Pleistocene) shoreline. Üçağızlı Cave was discovered and first investigated by A. Minzoni-Déroche (1992). The current project, a joint effort of the University of Arizona and Ankara University, began with test excavations in 1997, followed by full-scale excavations in 1999 and 2000 (Kuhn *et al*. 1999, this volume). Üçağızlı Cave preserves a sequence of early Upper Palaeolithic assemblages that span roughly 10,000 years, which includes the transition from the initial Upper Palaeolithic to something resembling the early Ahmarian.

Exposed in a north-south section (Figs. 3.8 and 3.9) is a sequence of inter-fingering clays, ash-rich clays and ashes that locally contain cm-sized bone and rock fragments. The clay units are generally massive to crumbly, locally containing some ashy inclusions, and are commonly in aggregated form. These sediments tend to be locally cemented, particularly when situated below bedrock overhangs. The ashy lenses are thickest and more abundant in the northern part of the profile and thin out to the south. Although these general relationships are visible in the field, contacts between layers and specific boundaries are locally blurred because of the cementation and the crumbly nature of the sediment.

Some of the lithological aspects of these deposits in the southern profile (Fig. 3.9) are worth examining in detail. Sample UC99-2a, for example, comes from the base of the profile (Fig. 3.10a) and consists of bright red clay in the form of cm-sized aggregates with quartz silt, all of which are locally cemented with calcite. Massive ashes at the top of the sample contain abundant clay aggregates with no bedding. Although there is little charcoal, where present, it is locally mixed in by bioturbation. All in all, the chaotic nature of this ash suggests that it has been colluvially reworked or intentionally dumped.

Sample UC 99–3 from just above the previous sample (Fig. 3.9) is a generally similar type of deposit, comprised of a mixture of clay aggregates and ashes that are often cemented. Isolated splinters of bone and charcoal appear locally, and these also appear to be bioturbated (Fig. 3.10b). As above, this sediment is suggestive of a mix of ashes and colluvial red clay.

Sample UC 99–4a (Figs. 3.9 and 3.10c), on the other hand, is mostly clay with isolated rhombs of calcareous ash that point to reworked ash within the clay, which is colluvial in origin. Bone fragments (some of which are calcined) have rounded edges, although it is not clear if this phenomenon is due to geological processes (*e.g.*, rolling) or biological ones (*e.g.*, digestion; Horwitz and Goldberg 1989).

Sample UC 99–6 (Figs. 3.9 and 3.10d) from the middle part of the profile is a chaotic mixture of massive, cemented ashes with abundant burnt bone, and angular, fresh fragments of red clay. The angularity of the latter tends to rule out rolling motion as would be produced by colluvial movement down a slope, and it is more likely that fragmentation occurred in place, possibly by trampling.

At the northern end of the site (Fig. 3.9), a relatively small niche is filled with massive ashes interbedded with decimetre-thick beds of red clay (Figs. 3.11a and 3.11b). This photograph was taken at the end of the 2000 campaign. During the previous, 1999 season, a mass of ashes was uncovered that accumulated east of a line of boulders, possibly a windbreak (?). At the base of the profile (above the bucket in Fig. 3.11a), sample UC-00–118 includes a sequence of red, dense clay (locally cemented). It is overlain by hard to friable and chalky, partly cemented ash. At the top is a porous mixture of partly cemented, round clay aggregates with some ash and burnt bone (Fig. 3.12a). A detailed view of the ashy layer (Fig. 3.12 b) shows a disorganized mixture of ash and aggregates of ash, along with inclusions of rounded clay aggregates. Just above this in sample UC-00–117, is a cemented, massive chalky ash with fine pores, charcoal, and bone (Fig. 3.12c). While the ash is thicker than in the underlying deposit (sample UC-00–118), the overall structure and composition is quite similar, even though bedding in the ashes is quite evident in the middle of the thin section (Figs. 3.12c and 3.12d). Although specks of charcoal are scattered throughout the ash, they are not concentrated at the base of the ash, as might be expected to result from an *in situ* burning event.

Sample UC-00–122 comes from a stratigraphic unit just above sample UC-00–117, but *ca*. 1 m to the north (left in Fig. 3.11b). In the field these sediments consist of two layers: an upper midden-like unit and a lower ashy unit. The upper layer is soft, crumbly (but locally cemented) clay, and rich in bone; it has a distinct yellowish brown colour (5YR 4/6; yellowish red) in comparison to most of the other clayey deposits in the site, which are dark reddish brown (5YR3/4). The lower layer is *ca.* 5 cm thick, loose to powdery, and quite homogeneous. These units are illustrated in Fig. 3.12, which shows the abundance of inclined bones in the upper clayey part, and the underlying much looser, aggregated lower part. The overwhelming amount of loosely bound heterogeneous aggregates in the latter is indicative of bioturbation, a feature suggested by field observations. In any case, the inclined nature of the bones sloping toward the back wall of the cave (Fig. 3.12e) is reminiscent of anthropogenic, organic and ash, components that would be found in a midden deposit accumulated through the action of dumping, or a similar type of refuse accumulation process.

Thus at Üçağızlı Cave, we have two basic sedimentary components: red clay and ash. The former is essentially reworked terra rosa soil that has been washed over the brow of the cave to accumulate as small cones on its floor (Fig. 3.8), which then served as local clay sources resulting in wedge-shaped clayey accumulations (Figs. 3.9, 3.11a and 3.11b). Coeval with this geogenic activity is the widespread accumulation of calcareous ashes that locally exhibit concentrations of bone, and only scatters of charcoal, which are surprisingly few in light of the amount of ashes that can be observed. The quantity of ash is particularly noticeable in the north end of the cave (Figs. 3.11a and 3.11b), where it interfingers with relatively steeply dipping bone and clay-rich units (Fig. 3.11b). Judging from the amount of ashes at the site, their mixed (with red clay aggregates) composition, the wide-ranging paucity of charcoal, and the dumping/midden accumulation of the bone layers, it seems that most if not all of the ash accumulations at Üçağızlı are the result of human dumping of ashes and not the result of *in situ* burning events. *In situ* fireplaces are rare at the site (at least in those areas so far excavated). When they do occur (two or three were observed in the area shown in Fig. 3.9), they are epitomized by mm- to cm- thick stringers of charcoal and ash resting on a rubefied clay substrate ≤1 cm thick; they are of a much smaller scale than the ash layers found throughout the site.

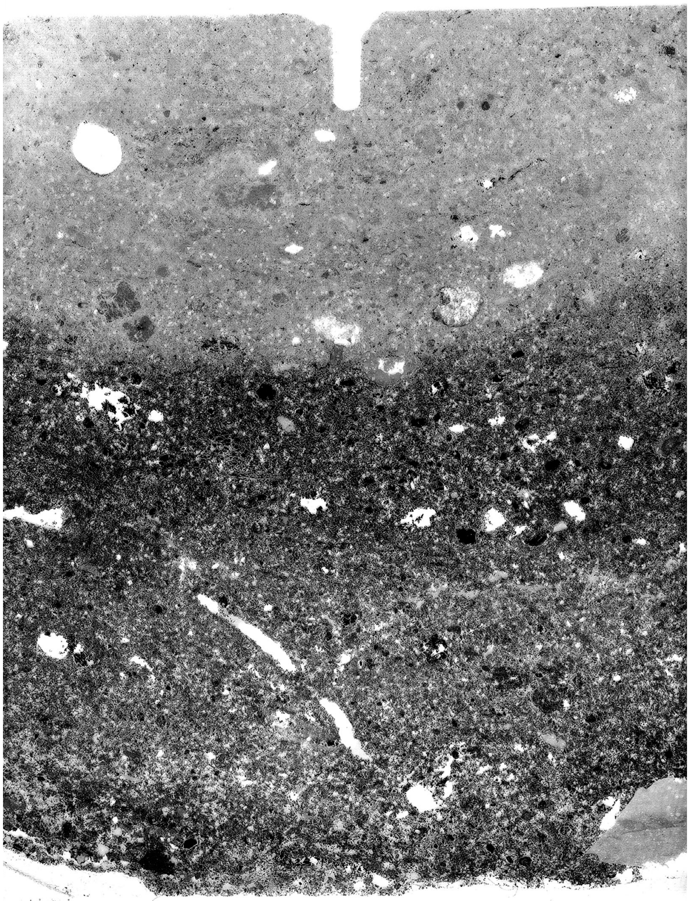

Fig. 3.7a

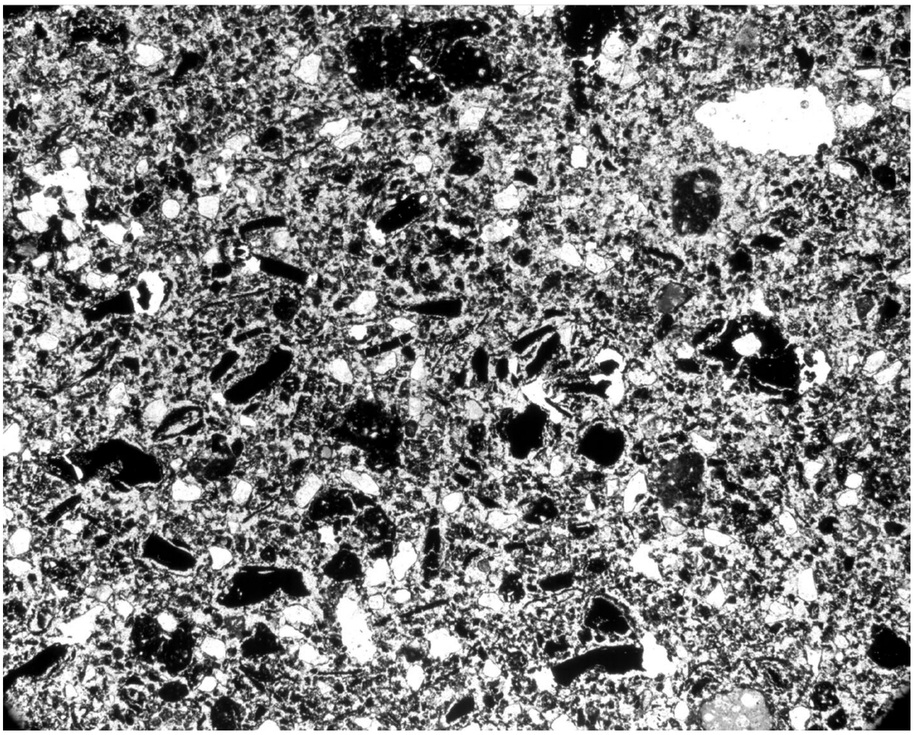

Fig. 3.7b

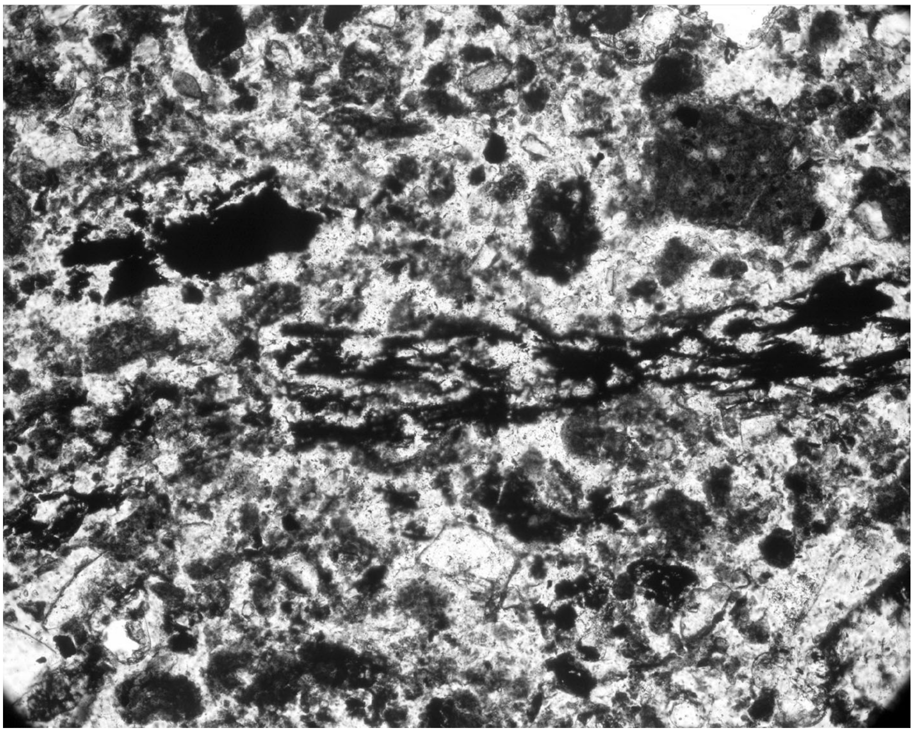

Fig. 3.7c

Fig. 3.7 (a) Macrophotograph of Upper Palaeolithic hearth (unit IIIA) from Kebara. Length of field = ca. *65 mm. (b) Photomicrograph of darker, charcoal-rich zone in (a). Note the fine grained, splintery nature of the (non-woody?) charcoal and the generally open fabrics. The latter are significantly different from those of the Middle Palaeolithic, which tend to be more compact, and with more massive charcoal. PPL; length of field* ca. *3.3 mm. (c) Detail of (b). Note the splintered nature of the charcoal. PPL; length of field =* ca. *550 µm.*

Fig. 3.8 View of Üçağızlı Cave looking down from the cliff face. The section shown in Fig. 3.9 is the trench in the lower right; the section shown in the alcove in the northern end of the cave behind the standing figure is shown in Fig. 3.11. South is to the lower right and north to the upper left.

Fig. 3.9 Üçağızlı Cave showing interbedded ashes and red silty clay from trench shown in Fig. 3.8; a clay layer rich in bone occurs in the upper left of the photograph. Sample numbers are shown by hanging tags. The vertical part of the folding metre is 1 m long.

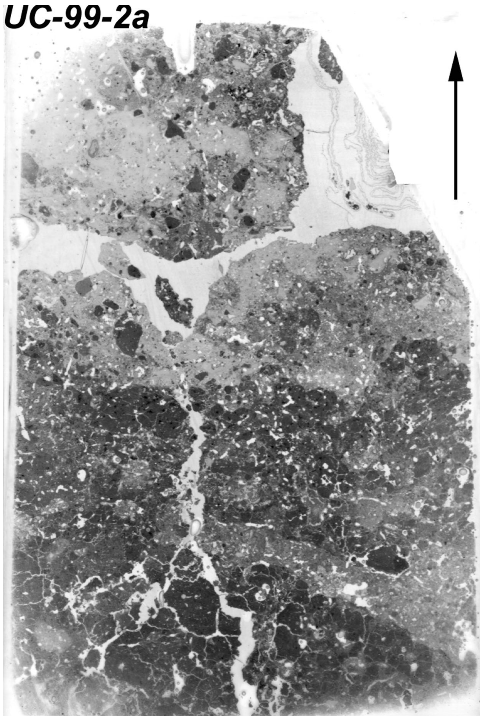

Fig. 13.10a

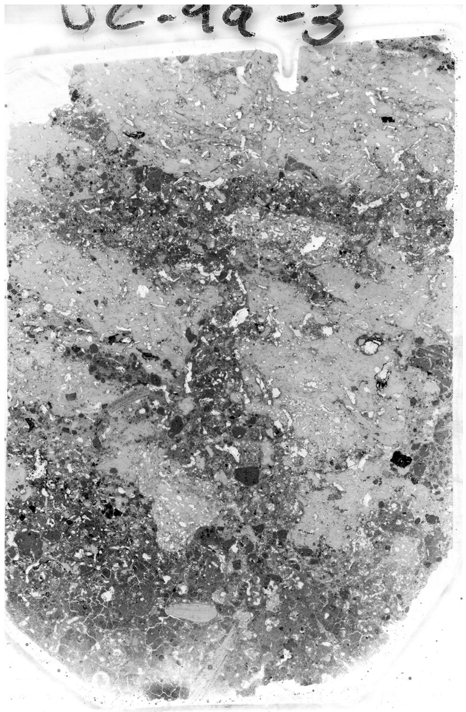

Fig. 3.10b

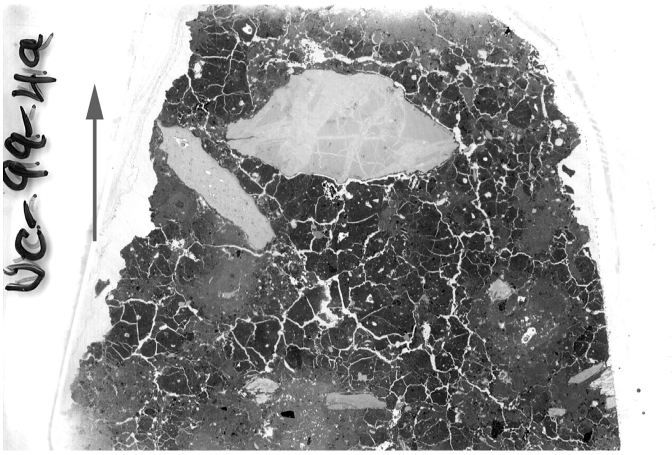

Fig. 3.10c

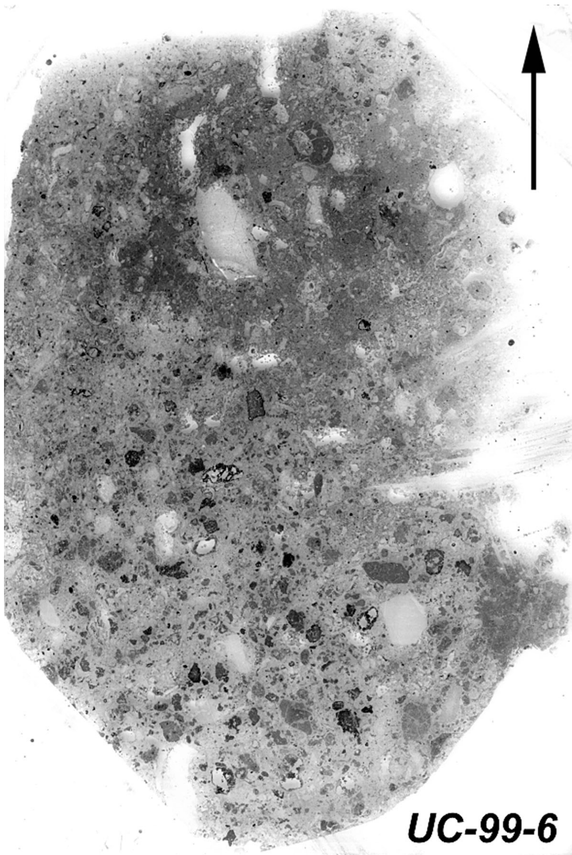

Fig. 3.10d

Fig. 3.10 Macro photographs of thin sections from profile shown in Fig. 3.7; number in each thin section corresponds to that in the profile. In all, note the intermixing of ash and red clay. Scale for all: maximum dimension is ca. *75 mm. (a) Sample UC-99–2a. From base of profile, showing ash-rich aggregates mixed with predominantly clay at the top. (b) Sample UC-99–3. Ashy sediment with clay. Ashes commonly cemented and at top appear to be bedded and* in situ. *(c) Sample UC 99–4a. Aggregates of clay with inclusions of isolated ash rhombs. Ashes and clay cemented. Some cracks in clay show thin clay coatings. Bone is quite rounded on edges; some is calcined. (d) Sample UC 99–6. Chaotic mixture of massive ashes, much burnt bone with angular pieces of red clay. These elements are fresh and appear broken in place, probably by trampling and not by a rolling motion.*

Fig. 3.11a

Fig. 3.11b

Fig. 3.11 (a) North end of Üçağızlı Cave showing a section dominated by massive ashes interbedded with reddish clay above and below. Note the dipping bone-rich layers at the left. Squares delineated by strings are 2 x 2 m. (b) Detail of stratigraphic section above the bucket in (a), showing location of samples. The vertical length of the folded metre at the left is ca. *90 cm long.*

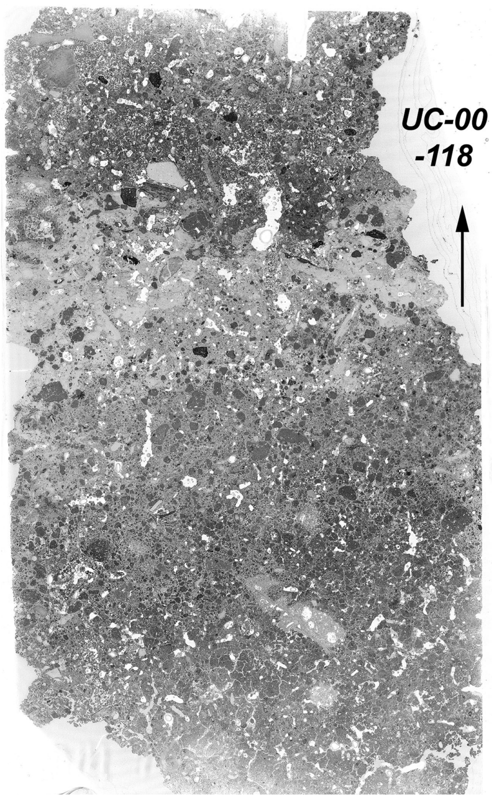

Fig. 3.12a

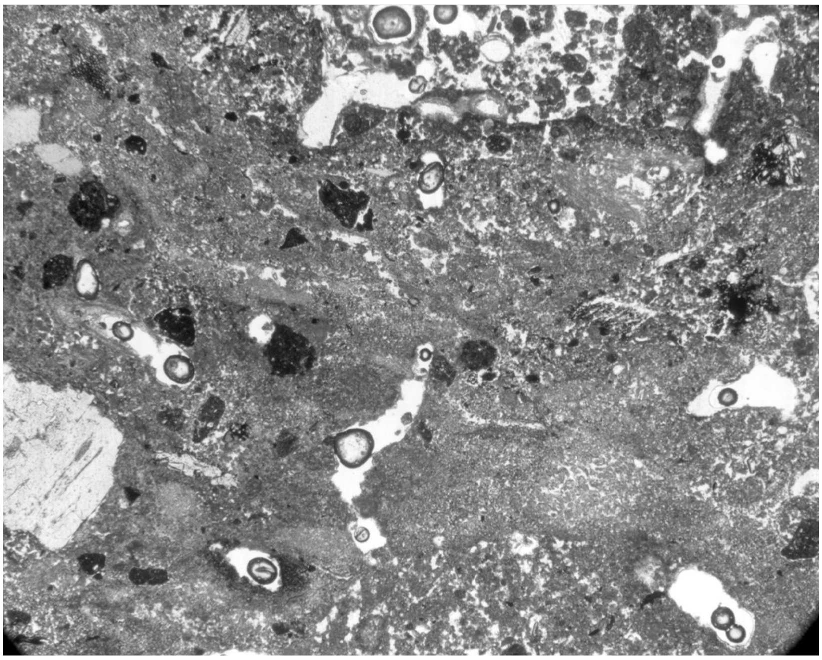

Fig. 3.12b

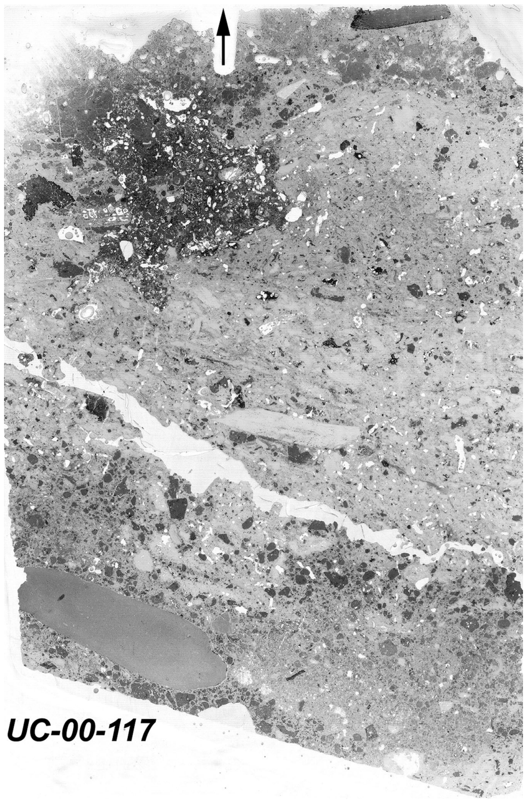

Fig. 3.12c

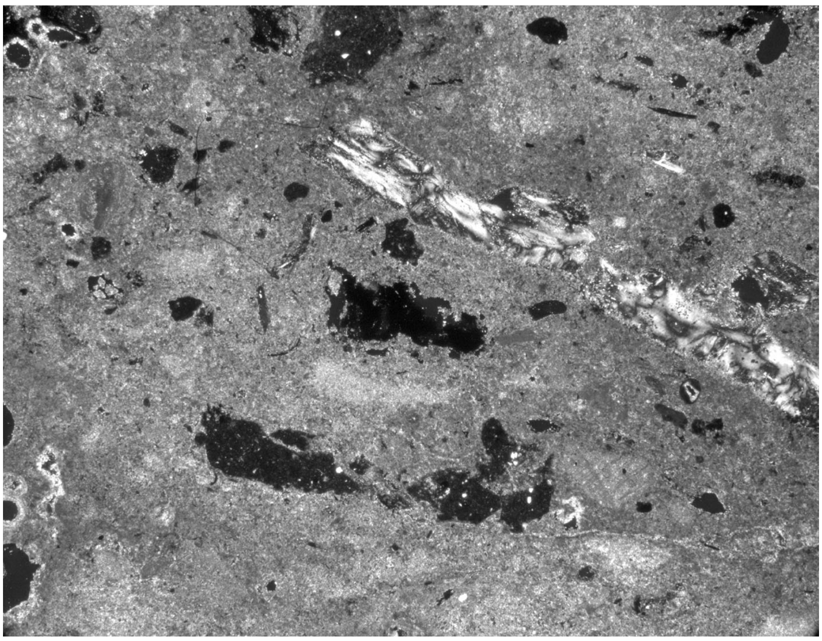

Fig. 3.12d

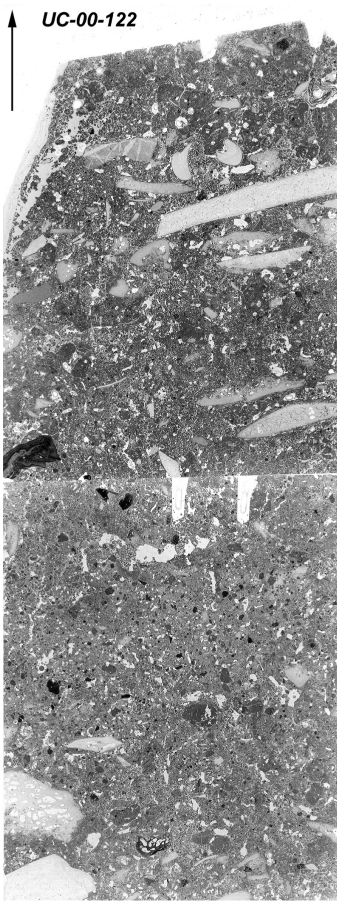

Fig. 3.12e

Fig. 3.12. Macro and microphotographs of samples from profile in Fig. 3.11b. (a) Macrophotograph of sample UC-00–118 from lower right-hand corner of exposure in Fig. 3.11b. The prominent ash band corresponds to that in Fig. 3.11b. Length is ca. *73 mm. (b) Detailed photomicrograph of sample UC-00–118 showing a chaotic mixture of clay aggregates mixed with ash and ash aggregates. PPL; width of field =* ca. *3.3 mm. (c) Macrophotograph of sample UC-00–117 from just above sample –118. Note that although the ash here is much thicker than in (a), the overall composition and organization is similar. (d) Detailed view of ash in central part of sample UC-00-117 with elongated bone fragment that is parallel with the dipping deposits (*cf. *c). XPL; width of field =* ca. *3.3 mm. (e) Macrophotograph of sample UC-00–122 from the left-hand portion of the section in Fig. 3.11b. Note the dip of the numerous bone fragments in the upper part of the profile, likely representing dumping of these materials. The loose, aggregated, and structureless nature of the lower part points to bioturbation of these deposits. Length =* ca. *140 mm.*

Discussion and Concluding Comments

Most archaeological inferences are based on the occurrence of material remains excavated from a site. Such material vestiges might normally include lithic remains, pottery and metals, features, and faunal and floral remains. Yet, ironically, the notion of archaeological sediments forming an integral part of the material culture is commonly overlooked. Although various aspects of the sediments have been examined in the past, typically phosphorous or trace elements (*e.g.*, Eidt 1977; Middleton and Price 1996), until recently not much attention has been paid to macro- and micro-aspects of anthropogenic deposits as indicators of specific human activities. Micromorphological studies have begun to remedy this situation (*e.g.*, Courty *et al.* 1989, 1991; Macphail and Goldberg 1995; Macphail *et al.* 1990; Matthews 1995, Matthews *et al.* 1996, 1997).

The point here has been to show the similarities and differences among the anthropogenic sediments relating to burnt, ashy deposits from Middle and Upper Palaeolithic deposits from Kebara and Üçağızlı Caves and how these might reflect upon human activities of both Neanderthals and anatomically modern humans. At Kebara, for example, we are able to observe a variety of activities relating to burning. These included *in situ* hearths characterized by structured elements consisting of couplets of organic/charcoal-rich material overlain conformably by ash; these couplets rest either on a mineral substrate or one produced by a previous burning event (Figs. 3.2 and 3.3). Somewhat similar 'sedimentary structures' can be observed for *in situ* fires within the Upper Palaeolithic deposits of Kebara as well (Figs. 3.6, 3.7a, 3.7b, and 3.7c), although because of diagenesis the internal composition and fabrics of these sets of burnt layers differ from the Middle Palaeolithic to the Upper Palaeolithic.

In Kebara, stratigraphically equivalent layers to the well-structured Middle Palaeolithic burnt features were expressed by bedded, charcoal-poor accumulations of ash with red clay stringers (Figs. 3.4 and 3.5). These accumulations were banked up against the northeast wall of the cave, and inter-fingered with massive, metre-thick accumulations of bone midden interspersed with red clay. Such deposits do not display the structural differentiation or composition of anthropogenic features formed in place, and suggest the repeated dumping of these components by the Neanderthal inhabitants. The fact that the ashy components interfinger with massive accumulations of bone that are also banked up against the cave wall, indicates an association of alternating discarding activities, which occurred repeatedly for centuries or millennia judging from the stratigraphic position of these deposits and their thickness.

Interestingly, for Üçağızlı Cave that appears to have only Upper Palaeolithic and later deposits, the physical vestiges of *in situ* burning are thin and meagre, and at

present, are confined to *ca*. 1 cm thick burning features. No *in situ* burning activities of the style and scale similar to those found in Kebara – either in the Middle Palaeolithic or Upper Palaeolithic layers – have been so far found at Üçağızlı. In contrast, most of the deposits at Üçağızlı are either reworked terra rosa clay of predominantly geogenic origin, or dumped ash deposits. Furthermore, as at Kebara, the ash deposits in the northern chamber interfinger with localized bone accumulations that manifestly dip toward the northern wall (Fig. 3.11), again suggesting midden-like disposal of both bones and ash.

These two examples are, without doubt, not unique in the archaeological record. Yet they serve to underscore the notion that archaeological sediments – whether or not from what one would call 'features' – constitute a vital archaeological resource that is no less valuable or essential for interpreting the archaeological record in all its aspects than are the more traditional archaeological data-sets.

Acknowledgments

I would like to warmly thank my colleagues who have indirectly or directly helped contribute to this study. In particular, I am grateful to Steven L. Kuhn for information, field and laboratory support for the Üçağızlı sediments, and to L. Meignen and O. Bar-Yosef for collaboration on the Kebara Cave sediments.

4. The Levantine Upper Palaeolithic Faunal Record

Rivka Rabinovich

Introduction

Several cultural entities of small, mobile hunter-gatherer bands existed during the Upper Palaeolithic, *ca.* 45–20,000 bp, in the Levant (Gilead 1991, 1995a; Bar-Yosef and Belfer-Cohen 1988). However, despite its relatively long duration, little is known of Upper Palaeolithic subsistence patterns, though they can be illuminated by the reconstruction of the interactions between humans, environment and the available floral and faunal resources.

The distribution of Upper Palaeolithic sites among cave, rockshelter and open-air occupations is uneven throughout the Levant. In the Mediterranean zone a number of caves were investigated, but almost no open-air sites, while arid zone sites are primarily in the open-air (see Figs. 1.1–1.5). In any event most sites seem to have been ephemeral (Gilead 1995a), and some have correlated this settlement pattern with seasonal variability (*e.g.*, Binford 1968). Evidence for Upper Palaeolithic subsistence patterns derives mainly from animal and charcoal assemblages, since few macrobotanical remains have been recovered. Identified charcoal remains were reported from Mt. Carmel, the central Negev and southern Sinai (Bankroft 1937; Liphschitz and Waisel 1977; Phillips 1988; Baruch *et al*. 1992). In addition, sporadic pounding/grinding tools for processing vegetal foods are attested (*e.g.,* Bachdach 1982; Bar-Yosef and Belfer-Cohen 1988; Belfer-Cohen and Bar-Yosef 1981; Bergman 1987; Ronen and Vandermeersch 1972).

In the following paper a critical examination of the current state of faunistic research based on Levantine Upper Palaeolithic assemblages will be summarized.

Palaeoenvironmental Background

The paucity of and different interpretations of Upper Palaeolithic palaeoenvironments from a variety of sources has led to considerable confusion. The evidence is based on pollen diagrams, geomorphological studies, isotopic studies of speleothems, and faunal assemblages (Bar-Matthews *et al*. 1997a, b, 1999, this volume; Davis 1977a, 1981; Dayan 1994; Goldberg 1986; Goodfriend and Magaritz 1988; Goring-Morris and Goldberg 1991; Tchernov 1981, 1991a; Weinstein-Evron 1990, 1993, 1994). These methods are complementary, but, in order to examine biotic/cultural patterns related to climatic changes, a secure chronological basis is required (Goring-Morris and Belfer-Cohen 1997). Unfortunately, few radiometric dates for the time interval of the Upper Palaeolithic are available (Phillips 1994; and see Appendix).

Pollen cores indicate relatively humid and cold conditions through the Upper Palaeolithic, with two major humid phases, *ca*. 45–33/32,000 bp and 30–22,000 bp, with a drier phase in between (ca. 33/32–30,000 bp). In accordance with other evidence (see below) extreme cold and dry conditions prevailed *ca*. 22–19,000 bp. Geomorphological studies in the Negev and Sinai appear to broadly parallel these results, with increasing aridity and erosion, *ca*. 25–18,000 bp. The speleothem study in Soreq Cave, in the Judean Hills, indicates four cold peaks at 46, 35, 25 and 19 ky, and two warm and wet peaks at 54 and 36 ky. The 19 ky event is considered to be the coldest and driest.

Climatic reconstructions are based on faunal studies that refer to changes in animal size, species distribution and species diversity (*i.e*., relative abundance of the species). Many mammalian species tended to be larger during the Upper Palaeolithic than today, thus implying colder conditions, *e.g.*, gazelle, fallow deer, hare, fox and wild boar (Davis 1981; Tchernov 1981). A diminution in the size of several mammals *ca.* 12,000 bp was interpreted as reflecting warmer conditions. But animal size is not only climate dependent, as indicated by carnivore studies, where competition (per species and related guilds) clearly influences body size (Dayan *et al*. 1991).

Species distribution and diversity were seldom used as an environmental proxy. 'Bate's graph,' based on the fauna from the Mount Carmel (Tabun and el-Wad caves) excavations, indicated that the changing relative ratios of *Gazella* and *Dama* reflect alternating dry to moist climatic conditions (Bate 1937). Garrard (1982: Fig. 9.2) published very different species counts from el-Wad Cave

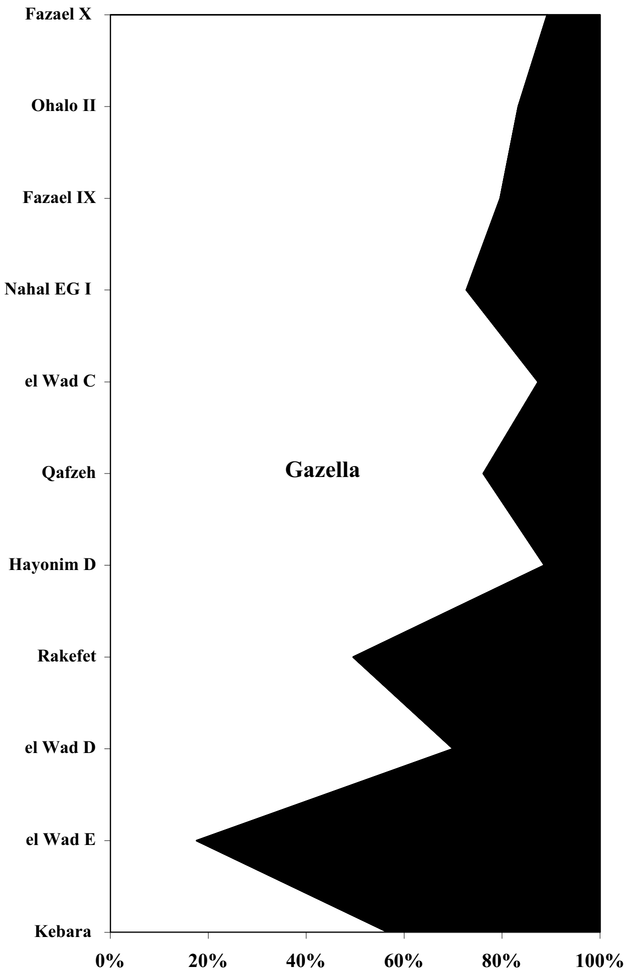

Fig. 4.1 The 'Gazella-Dama Graph' of selected Upper Palaeolithic assemblages.

that completely changed this interpretation. While incorporating various assemblages (Fig. 4.1) it seems that, as a rule, gazelle predominate (but for el-Wad E and Raqefet). Though *Dama* is not an arid environment species, it is quite flexible and adaptive to various habitats from rocky arid scrub to deciduous forest. It is thus not suitable for environmental reconstructions in the Mediterranean zone during the Upper Palaeolithic, although its presence in marginal areas does reflect climatic changes. Hence, other methods and species are much more reliable for examining climatic fluctuations (see also Davis 1982:6).

During the Upper Palaeolithic an abrupt change in the relative frequencies of rodents is observed with an increase in the relative abundance of arboreal species (*Sciurus anomalus*, *Dryomys nitedula*, *Apodemus flavicollis*) and a decrease of open landscape species (*Microtus guntheri*) (Kebara, Hayonim and Sefunim assemblages; Tchernov 1998). This change is taken to indicate the onset of cool and humid conditions with a dominance of oak forests in the region.

The Archaeozoological Record

Methods of Analysis

Faunal studies provide an invaluable source for investigating subsistence, local environments and human impact on the environment. Local conditions determine the variety of exploitable resources available, though overkill or culling by age and sex can also influence natural distributions. Human interference is unlikely to have had a significant effect on Palaeolithic species' distributions, yet micro-local impacts on immediate site surroundings are possible. Seasonality of occupation can reflect fluctuations in resource availability, which should be detectable in the faunal spectra.

Animal remains provide information on what was eaten and how food was exploited. But are cultural changes also reflected in the faunal remains? The assumption adopted herein is that the faunal remains do portray human food acquisition methods. It is widely accepted that a change in food procurement strategies occurred in the Levant sometime between the Mousterian and the Natufian. Yet, when and where this change occurred, and whether it was sudden or gradual remains to be addressed. Although Levantine Upper Palaeolithic faunal spectra are well documented, procurement and consumption modes have hardly been addressed. The following questions are pertinent – what economies did groups practice? What were the mobility strategies? What types of sites were occupied? Were they seasonally occupied? What species were taken? Were animals hunted as isolated prey or by mass kills? What procurement technologies were used? What factors determined prey transport decisions? What butchery methods and processing modes, such as marrow and fat extraction, were used?

Taphonomic studies are used to understand the formation processes of faunal assemblages. These address issues such as:

1. Post-depositional processes (chemical changes, weathering, *etc*.).
2. Human exploitation patterns (procurement techniques, sex and age culling, butchery practices, *etc*.).
3. Animal activities (carnivore hunting and scavenging, rodent burrowing)

Not all species present in site assemblages are anthropogenic. Most micro-mammals, many birds and reptiles occupy caves or sites' surroundings and were introduced into the assemblages naturally or by other agents. Remains from human hunting and gathering can be highly variable depending on food gathering methods, prime food components, storage facilities, sharing, mobility and social networks. Each factor shaping hunter-gatherer societies can be variable, leaving complex patterns of residues. No single pattern is to be expected, as formation processes were not compartmentalized closed systems. Some variability is to be expected even in a limited geographical area, and within any cultural tradition.

The Faunal Record

Most of the larger Upper Palaeolithic faunal collections derive from cave sites in the Mediterranean zone – see Tables 4.1–4.2 (Bate 1937; Bouchud 1974; Davis 1977b; Garrard 1980; Hooijer 1961; Kurten 1965; Rabinovich 1998a; Speth and Tchernov 1998; Speth in Bar-Yosef *et al.* 1992; Tchernov 1968, 1981; Vaufrey 1951). Notwithstanding the ephemeral nature of most sites, variations occur in the composition of faunal assemblages: in the presence and activity of hyena, in evidence for butchery (including birds), and sharing.

The most common mammalian species are gazelle (*Gazella gazella*) and fallow deer (*Dama mesopotamica*). Other species include red deer (*Cervus elaphus*), aurochs (*Bos primigenius*), wild goat *(Capra aegagrus*), boar (*Sus scrofa*) and equid (*Equus caballus*), as well as small-sized carnivores (*e.g*., fox – *Vulpes vulpes*). Smaller animals including rodents, reptiles, birds, fish and snails were also recovered (Tchernov 1988).

An accepted view is that hunted faunas reflect immediate site environments (Higgs 1967; Davis 1982; Garrard 1980, 1982). Indeed, regional fluctuations in species composition occur. Thus fallow deer is the commonest species in northern sites, *e.g.* Ksar Akil, where wild goat is also common. In the Carmel and Galilee gazelle (*Gazella gazella*) predominate. By contrast, in the arid areas of eastern Jordan, the gazelle species represented is probably *Gazella subgutturosa*, while the equid is probably *Equus asinus/hemionus*, which also appears in the Negev (Martin 1994, 1999; Davis 1980).

It is generally accepted that Middle and Upper Palaeolithic food acquisition techniques differed, reflected in a shift from large mammals during the Middle Palaeolithic to gazelle-sized smaller mammals during the Upper Palaeolithic (Bar-Yosef 1998a, 2000).

The faunal record of the Levantine Upper Palaeolithic suffers from five major problems:

1. Inadequate retrieval methods, especially for some of the early excavations at key sites, *i.e.* Ksar Aqil, el-Wad, *etc*., where little if any sieving was carried out.
2. Nature of faunal reports, where quantitative information is often unavailable. Old reports commonly lack information on aging, sexing and body part distributions.
3. Small sample sizes (per site), which can be attributed to the ephemeral nature of occupations or/and the sizes of excavated areas and retrieval methods employed.
4. Most faunistic studies do not provide taphonomic details, so that information on post-depositional effects, procurement patterns and carnivore damage is lacking.
5. Poor preservation, especially in more arid areas, where small samples reflect natural bone destruction and/or the real ephemeral nature of occupations.

In the following pages I shall try to provide an updated regional description of the faunal assemblages, first by site with an emphasis on the medium-sized mammals and then by particular groups that commonly tend to be ignored. Taphonomic aspects will be referred to when data are available, and two examples of how taphonomic analyses can contribute to understanding faunal remains will be presented in more detail. Finally I will try to summarize and trace possible trends and characteristics of various Upper Palaeolithic manifestations in the Levant based on the faunal evidence.

Sites

The compositions of Levantine Upper Palaeolithic faunal assemblages are summarized in Tables 4.1 and 4.2[1]. Most assemblages derive from inadequate sieving, and reports commonly lack quantification (Garrard 1980).

Lebanon and Syria

Taxonomic analysis was undertaken for the vertebrate remains from the long sequence in the coastal rockshelter of **Ksar Akil XXIV–IV**, with quantification provided only for the cervids and bovids, but little information on body part distributions (Hooijer 1961). *Dama* dominates all levels. *Testudo* is present in several levels, as are snakes and birds and a very few microfaunal elements including porcupine (*Hystrix* cf. *indica*). Small, medium and even a few large carnivore remains (*Ursus arctos*, *Crocuta crocuta*, and a large *Felis pardus*) were also reported.

In the adjacent sites of **Antelias** and **Abri Bergy** *Dama* predominates, followed by wild goat, roe deer and rare wild boar (Hooijer 1961). A single *Ursus* specimen is mentioned from Abri Bergy.

At nearby **Abu Halka** *Dama mesopotamica* is also the most common species, in addition to red deer, gazelle, roe deer, boar, onager (*Equus* cf. *hemionus*?), wild cat, fox and jackal (?*Canis* [*aureus*?] see Haas in Haller 1942–3). Many unidentified birds, some tortoises (*Testudo ibera*), fish vertebrae and terrestrial and marine molluscs were also present.

In the Adlun cave site of **Mugharet el-Bezez A** a small assemblage of fallow deer, gazelle, a few *Testudo* plates and several bird bones was recovered (Garrard 1980, 1982).

Inland, on the eastern flanks of the Syrian Anti-Lebanon the **Yabrud II–III** rockshelters provided small faunal assemblages comprised mainly of equids (*Equus hemionus*?) and *Capra* cf. *ibex* (Lehman 1970). The many unidentifiable broken bones were thought to result from intentional anthropogenic activity.

Northern Israel

Galilee

Only the faunal assemblages from the Levantine Aurignacian layer D at **Hayonim Cave** in western Galilee

are pertinent to the present topic (Bar-Yosef and Tchernov 1966; Davis 1974a, 1981, 1982, 1983; Dayan 1989, 1994; Tchernov 1984a; Rabinovich 1998a, b). Gazelle is the most abundant species in all sub-layers, followed by *Dama*, while other species occur in very low percentages. *Vulpes vulpes* is the most common carnivore, followed by wild cat (*Felis silvestris)*. Of the gazelle between a third and a quarter of the bones were unfused. In all layers male gazelles predominate. The relative frequency of commensals, especially mice, increases significantly during the Aurignacian, reflecting an increase in occupation intensity. The bird remains are currently under study (see below).

Both the Upper Palaeolithic macrofaunal and microvertebrate remains of **Qafzeh Cave**, in lower Galilee overlooking the Jezreel Valley, have been studied (Bouchud 1974; Haas 1972; Tchernov 1981). Bouchud's analysis included the material from the 1965–1969 (Vandermeersch) excavations, as well as the remains from Neuville's earlier excavations. Gazelle was the most prolific species in all layers, followed by cervids and bovids (Bouchud 1974: Tableau III). Similar distributions observed in a recent study show the mountain gazelle to be the most common species (20%), and the small mammal group (BSGD, see list of abbreviations accompanying Tables 4.1 and 4.2) is the largest group (24%) (Rabinovich 1998a). The various cervid species occur in similar frequencies: fallow deer (7%), red deer (6%), and roe deer (6%). Other mammal species are quite rare. Carnivores are generally quite frequent, comprising 7%. The sex and age distributions provided only a rough indication of age profiles, but the presence of young animals is notable. Haas (1972) described the presence of Amphibia: Anura (*Bufo*); Reptilia: Agamidae, Lacertidae, Ophidia; Aves and Chiroptera, as well as small mammals: *Sciurus*, *Spalax*, *Myomimus*, *Gerbillus*, *Meriones*, *Microtus*, *Apodemus*, *Rattus*, and *Mus*.

Mount Carmel

A small Upper Palaeolithic faunal assemblage derives from the base of the first chamber in **Raqefet Cave**, on the eastern flanks of the Carmel (Garrard 1980; Sarel and Ronen this volume). Juvenile gazelle comprise 24% (n= 29). *Testudo* plates were found in all layers suggesting human foraging, and birds were also present.

The few artiodactyl bones recovered from the Upper Palaeolithic levels 9–11 of **Sefunim Cave (Iraq el-Baroud)**, on the western side of the Carmel include boar, gazelle, wild goat, *Alcelaphus* sp., bovid, roe deer and fallow deer (Tchernov 1984b). Various rodents, carnivores, birds, reptiles, amphibians and fish were also reported.

Large faunal assemblages were recovered from layers F-C at **el-Wad Cave** (Bate 1937; Garrard 1980). Interestingly, no non-mammalian species were reported from these layers, in contrast to the later periods (Garrard 1980: Table 5G). Gazelle predominates in layers D and C. Age distributions showed that 30–50% were juvenile, while a few were killed at advanced ages. Juvenile proportions for *Dama mesopotamica* vary between 8–40%, with no chronological trends, suggesting the targeting of prime age animals for most species but gazelle and boar, both of which were taken young. Sexual dimorphism for layers E and C (the only levels with adequate sample sizes) was similar for both gazelle and fallow deer. However, body part distributions indicate that while whole gazelle carcasses were brought back to the site, fallow deer remains were selectively introduced (Garrard 1980:187).

Very large Upper Palaeolithic faunal assemblages have been recovered from the various excavations of the long Upper Palaeolithic sequence at **Kebara Cave** (Bar-Yosef *et al.* 1996). Saxon (1974) examined the Turville-Petre collection, while Davis (1977b, 1982) studied the Stekelis collection. Faunal analysis of the previous and most recent excavations is currently being conducted by Speth (in Bar-Yosef *et al.* 1992, Speth and Tchernov 1998; Speth personal communication), focusing especially on the gazelle and fallow deer.

Intense carnivore activities were noted for both Mousterian and Upper Palaeolithic occupations at Kebara, with the presence of cubs clearly reflecting protracted denning. The age distributions of gazelle and fallow deer showed a slight increase in young animals and a decrease in very old ones during the Upper Palaeolithic compared to the Mousterian levels. Other Upper Palaeolithic characteristics included the presence of more males, and more modified bones, *i.e.* cut-marks, breakages, *etc*., of fallow deer than among the gazelle (Speth in Bar-Yosef *et al*. 1992).

Recent unpublished analysis of the Ahmarian-like units IV–III (NISP= 5,335; Speth personal communication) indicates the same trend of gazelle dominance (45%), followed by fallow deer (34%). Other species are represented by 1% or less, except for fox (*ca.* 2%) and tortoise (4.5%) (Tables 4.1 and 4.2). Burnt elements comprise 2% of the faunal assemblage (NISP= 112). No carnivore bones were burnt. Juveniles comprise 15% of gazelle, 20% of fallow deer and 33% of boars. Carnivore modified bones account for 14% of the fauna. Less than 1% of the Upper Palaeolithic bones are digested, while 4% have cut-marks and 1% bear both cut-marks and carnivore damage. *Dama* elements seem to be more modified than gazelle elements by both humans and carnivores (Speth personal communication).

Jordan Valley

Located in Wadi Amud, west of the Sea of Galilee the small, early Upper Palaeolithic assemblage from **Emireh Cave** included hare, camel (*Camelus* sp.), deer, gazelle, wild goat, aurochs (or *Bison*?), equid and rhinoceros, in addition to land snails (*Helix* [*Levantina caesare-*

ana])(Bate 1927). Limb bones are specified for the deer, gazelle and wild goat.

The small assemblage from the Late Upper Palaeolithic open-air site of **Nahal Ein Gev I**, located at the foot of the Golan Heights comprised mainly gazelle (42%) followed by red deer (33%) (Davis 1982).

Mountain gazelle (27%) dominates the faunal assemblage from the late Upper Palaeolithic-Early Epipalaeolithic waterlogged site of **Ohalo II** in the Sea of Galilee, followed by *Dama mesopotamica* (5%)(Nadel 1993, 1997a, this volume; Rabinovich 1998a). The BSGD accounts for *ca*. 50% of the assemblage, while the BSGB accounts for 8%. *Vulpes vulpes* comprise 2%, *Lepus capensis* 1% and the BSGE 3% of the fauna of Ohalo II. Other species, such as *Sus scrofa*, *Cervus elaphus*, *Bos primigenius*, *Capra aegagrus*, Hyaenid, and *Felis silvestris* are represented by several bones each, comprising less than one percent. Additionally the relative abundance of bird and fish bones amongst the faunal assemblage is especially noteworthy (Simmons and Nadel 1998; Zohar personal communication).

Faunal assemblages were also recovered from the late Upper Palaeolithic-Early Epipalaeolithic open-air sites of **Fazael IX–XI**, at the foot of the Samarian hills west of the lower Jordan Valley (Davis 1974a, b, 1977a, b, 1982, 1983). The reports include definitions of species, age, sex, size, comparison of species between periods, and relative abundance of species, though not damage patterns or modifications (but see Davis 1974b). Gazelle outnumber all other species in these Jordan Valley sites. Fallow deer is usually the next most common species. According to epiphyseal fusion and dental wear *ca*. 30% of the gazelles culled were <1 year old.

Judean Desert

The fauna from the long Upper Palaeolithic sequence at **Erq el-Ahmar** rockshelter, in Wadi Khareitoun was dominated by gazelle in Layers E, C, B, which were scarce in Layers F and D (Vaufrey 1951). Isolated teeth of *Capra ibex* were present in every layer. Other species including *Sus, Cervus elaphus* and *Bos* were rare. The equid bones present in each layer were originally defined as *Equus* cf. *mauritanicus*, but several teeth from Layer D were subsequently redefined as *E.* ?*asinus*/*hemionus* and *E. caballus* (Davis1980). Carnivores include *Ursus* in Layer D, *Felis pardus* in Layer E and, seemingly, remains of both hyaenid species, *Hyena crocuta* (*Crocuta crocuta*?) in Layer C and *Hyena* sp. in Layer D. In Layer B *Vulpe*s cf. *nilotica,* described as a smaller species than *Vulpes vulpes, is* probably actually *Vulpes ruepellii* (Vaufrey 1951).

Unfortunately, except for the molluscs (see below), the relevant faunal assemblages from the Upper Palaeolithic sequence at **el-Khiam** terrace were never published.

In the small open-air site of **el-Quseir** the Layer C, Levantine Aurignacian, faunal assemblage is dominated by gazelle, with cervid, ibex, boar, large horse (*Equus mauritanicus*?) and a large ?lynx, probably *Felis caracal*, in addition to land molluscs (Perrot 1956). Fewer species were found in Layer D, with only cervids and molluscs.

The nearby site of **Masraq en-Naj**, probably dating to the late Upper Palaeolithic-Early Epipalaeolithic, included many cervids and gazelles, fallow deer, a small equid and land molluscs (Perrot 1955).

Transjordan

Recent and ongoing excavations in Jordan have generally provided only preliminary reports, including the faunal assemblages. Furthermore, faunal preservation in more arid areas is very poor.

Of all the sites investigated in the Azraq basin, east-central Jordan, the only relevant faunal assemblage, dating to the late Upper Palaeolithic-Early Epipalaeolithic, is **Jilat 9** (Garrard 1998; Garrard *et al*. 1996; Martin 1994). The bones are highly fragmented so that only 9% were identifiable. Tortoise scutes outnumber remains of ass, gazelle and hare, suggesting a steppe or sub-desertic environment.

Numerous Upper Palaeolithic sites were found around the shallow lake swamps in Wadi el-Hasa, west-central Jordan (Coinman 1998a, b). Late Upper Palaeolithic-Early Epipalaeolithic **Ain el-Buhayra (WHS 618)** probably represents a basecamp on the marshy shore, but faunal remains are poorly preserved (NISP= 78) with most recovered from the spring area (Test H, I). Teeth of *Equus hemionus*/*asinus* dominate, with *Bos* sp. indet., ovicaprine and tortoise carapace scutes also present (Clark *et al*. 2000).

The late Upper Palaeolithic-Early Epipalaeolithic rockshelter of **Yutil el-Hasa (WHS 784)** was interpreted as a task site associated with hunting activities (Olszewski *et al*. 1990). The well-preserved but small assemblage included gazelle (*Gazella subgutturosa*, *Gazella* sp. indet.), equids (*Equus* sp. indet. and *Equus hydruntinus*), *Bos* sp. indet., ovicaprine and tortoise (Olszewski *et al*.1990; Clark *et al*. 2000).

The Upper Palaeolithic faunal remains from **Tor Hamar** rockshelter, in the Hisma region of south Jordan are scanty. Gazelle dominates layer F, with a few goat/sheep bones (Klein 1995b). Very few damage modifications were recorded, and the material is leached and highly fragmented. The body part distribution was explained mainly as a result of post-depositional effects.

Negev and Sinai

Notwithstanding extensive research in the Negev very few faunal remains were recovered due to poor faunal preservation.

The late Upper Paleolithic site of **Ein Aqev (D31)** yielded *Capra ibex, Gazella dorcas, Equus hemionis* and *Lepus* cf. *europaeous*. A single reptile bone of hardun (*Agama stellio*), and a few ostrich (*Struthio camelus*) eggshell fragments were also recovered (Tchernov 1976).

The Early Ahmarian sites of **Abu Noshra I–II** in Wadi

Feiran, southern Sinai yielded small faunal assemblages. At Abu Noshra I gazelle, boar, onager (or Nubian half-ass, *Equus hemionus*), ibex, fox and wolf were reported. At nearby Abu Noshra II aurochs, ibex, gazelle and onager elements were identified, as well as wolf and wild cat (Phillips 1988; Becker this volume). Birds (African fish eagle, *Haliaetus rocifer*), unidentified fish, and micro-fauna were also present.

Small Game Species

Small game species including micro-mammals, birds, amphibians, reptiles and molluscs are often found in archaeological contexts. They tend to be neglected in comparison to the emphasis given to the large and medium-sized mammals. In the following discussion their potential for archaeological research is outlined, where seasonality, environmental reconstructions and stylistic topics can be addressed, in addition to dietary issues (Table 4.2).

Lagomorphs

These represent one of the most important groups of smaller species, long known as a staple food source from the later Natufian. A recent time-transgressive taphonomic study of cape hare (*Lepus capensis*) remains included those from Early Ahmarian Kebara and Levantine Aurignacian Hayonim, which showed no signs of animal ravaging (Bar-El and Tchernov 2001). This indicates human agencies to be responsible for the observed fragmentation, suggesting a certain degree of purposeful hunting and/or trapping of hares throughout the Upper Palaeolithic.

Micro-mammals

Numerous micro-mammalian assemblages have been studied, focusing on species distributions, habitat reconstructions and presence of commensal species (Tchernov 1968, 1981, 1984a). Various taphonomic processes are responsible for the deposition and accumulation of micro-mammals. Marked differences occur in accumulation rates between cave and open-air sites, with fewer remains found in the latter due to accumulation modes and post-depositional processes (*ibid*.; Andrews 1990). Small mammals (rodents and insectivores) are usually regarded as good indicators of site habitats and their near surroundings, and are fine sensors of climatic changes (Kowalski 1995; Tchernov 1981, 1984a, 1988; and see above).

The presence of *Sciurus anomalus* in the Upper Palaeolithic layers of Ksar Akil attests to forest in the local environment, while *Erinaceus europaeus* indicates the nearby presence of woodland (Kersten 1992).

Commensal species (micro-mammals and birds) are considered indicative of occupation intensities, and, though commonly associated with Natufian sedentism, also occur earlier (Tchernov 1984a, 1991b). A decrease in the relative frequency of *Mus musculus* from the Middle to Upper Palaeolithic was noted at Qafzeh, Sefunim and Kebara caves[2], corroborating the ephemeral nature of the later occupations, as is also indicated by the overall sizes of the faunal assemblages (Tchernov 1984a). In Hayonim the relative abundance of commensal species, mainly *Mus musculus*, fluctuates along the sequence, being intermediate in the Mousterian, intensive in the Aurignacian, and low during the Kebaran (Tchernov 1984a). However, all these levels were interpreted as ephemeral, in comparison to the sharp increase of commensals during the Natufian occupation. The conclusions regarding the Aurignacian occupation thus correspond with the macro-mammalian study (Rabinovich 1998a), indicating that the increase in mice may reflect intensive occupation, '… though only for a restricted period of time and by a small group' (Tchernov 1984a:99).

Birds

Few Upper Palaeolithic reports on bird remains are available (Pichon 1991; Tchernov 1962). Although not substantive in the faunal repertoire, their presence illuminates site surroundings and seasonality. Seasonality was mentioned especially for the avifauna from Ohalo II (Simmons and Nadel 1998).

The birds of Ksar Akil reflect a mosaic landscape including forest (*Columba palumbus*), open woodland, open rocky country (*Gyps fulvus*, *Aegypius monachus*, *Aquila cf. chrysaetos*, and *Alectoris chukar*), and grassland (*Otis tarda*) (Kersten 1991). Standing or slow-flowing water surrounded by marsh vegetation is also indicated by *Anser* sp./*Branta* sp., *Anas platyrhynchos* and *Anas* sp. The griffon vulture (*Gyps fulvus*) is the most common bird. It prefers open rocky country with high cliffs and is a scavenger, feeding principally on carrion from medium to large-sized mammals.

The potential use of birds for food was examined at several sites (*e.g*., Ksar Akil, Sefunim, and Hayonim). At Ksar Akil, for example, neither gnawing signs nor cut-marks were observed (cut-marks were rare also on the ungulate bones). Burning was observed on bones of several species, including *Cygnus* sp., *Anser* sp./*Branta* sp., *Anas platyrhynchos*, *Gyps fulvus*, *Aegypius mona*chus, *Aquila* cf *chrysaetos*, *Aquila* sp., *Columba palumbus*, and other unidentified large-sized birds. Since burning usually occurred in association with food preparation, these species were interpreted as having been exploited for consumption by humans (Kersten 1991). The few Upper Palaeolithic bird remains at Sefunim Cave comprise the common cave dwelling pigeon (*Columba livia*), which could have been used for food (Tchernov 1984b).

The relatively large bird assemblage from Hayonim D (Levantine Aurignacian) is intriguing in the archaeological

context of a 'kitchen midden' (Tchernov and Rabinovich in prep.; Belfer-Cohen and Bar-Yosef 1981). Numerous cut-marks were observed on griffon vulture and other large bird bones in a repetitive manner and location, indicating systematic processing and, plausibly, hinting at exploitation of both feathers and meaty parts. Taken in conjunction with other aspects of the Upper Palaeolithic occupation at Hayonim similar modes of bird exploitation perhaps may profitably be sought in the European Aurignacian tradition (Mourer-Chauviré 1983).

The evidence at Ohalo II indicates that, by the end of the Upper Palaeolithic, birds were exploited in large numbers for both food and for their decorative value (Simmons and Nadel 1998).

Ostrich (*Struthio camelus*) eggshell fragments were recovered at numerous sites in the Negev and Sinai, *e.g*. Ein Aqev (D31), Shunera XVI, Qadesh Barnea 601 and Lagama X, probably representing food, containers and decorative uses (Tchernov 1976; Gilead 1977; Goring-Morris 1987).

Amphibia and reptiles

Information on amphibians and reptiles is scarce, and it seems they did not comprise a major food resource during the Upper Palaeolithic. The Aurignacian of Sefunim Cave yielded numerous burnt vertebrae and dermal scales of the legless lizard (*Opisaurus apodus*), together with numerous tortoise (*Testudo graeca)* and chameleon (*Chameleo chameleon*) remains. These could have provided '…a constant food supply' (Tchernov 1984b: 409). Elsewhere in south Levantine sites, tortoise (*Testudo graeca*), legless lizard (*Opisaurus apodus*) and land snails (*Helix* sp. and *Levantina* sp.) are among the most common small species (*ibid*.; Stiner *et al*. 1999).

Many faunal reports mention the presence of tortoise carapaces, though few present the frequencies of other body parts (Table 4.2). It is thus difficult to quantify their actual dietary contribution, especially since carapaces, commonly reported with signs of burning, can also be used as containers.

Aquatic Resources

Shell middens were never a typical archaeological manifestation along the eastern Mediterranean coast, and marine resources were not a major food item for Upper Palaeolithic populations in the region.

Fish

Although sporadic fish remains are reported from several sites, it is only at the very end of the Upper Palaeolithic, at Ohalo II on the shore of Lake Lisan, that evidence of fishing and bulk fish utilization is attested (Zohar personal communication; and see Table 4.2).

Molluscs

Molluscs in archaeological contexts require, as with any other biological find, proof of the agent of accumulation. Species that do not originate near the site are obviously imported, while local species should be further evaluated. Terrestrial snails seem to mostly reflect natural distributions in the immediate site environs. Signs of use and/or modification indicate intentional collection. Mollusc assemblages reflect procurement patterns, whether direct or by means of exchange.

Marine molluscs are found in many Ahmarian and Levantine Aurignacian sites (Table 4.2), usually originating in the Mediterranean (*e.g.,* Kebara and Hayonim, Bar-Yosef Mayer in press), sometimes far from their sources, as at Yabrud II, el-Khiam and Ein Aqev (distances of up to 100 km from the seashore). Variable quantities of shells are present in such northern Sinai sites as Qadesh Barnea 9, Lagama IIIA and, especially, Lagama X (Bar-Yosef Mayer in press; Gilead 1991:141). Marine shells were also found at Jebel Humeima (J412, J403) and in the early Ahmarian of Tor Hamar (J431) in south Jordan (Reese 1995).

Dentalium is the common species in most Upper Palaeolithic sites (*e.g*., Fazael X, Ohalo II). Other species include *Mitrella, Columbella, Arcularia, Smaragdia viridis, Trivia, Nassa gibberula, Pecten*/cockle and *Ancilla* (Bar-Yosef Mayer in press; Gilead 1991; Goring-Morris 1989a; Reese 1995).

In several cases marine shells were perforated (*e.g.*, Yabrud II, Masraq en-Naj, Üçağızlı) and primarily used as personal adornments[3], as '… another innovation of the Levantine Upper Palaeolithic' (Gilead 1991:141; see also Kuhn *et al*. 2001). Although sporadically recovered from earlier contexts '… only since Upper Paleolithic times do they [marine shells] occur consistently and sometimes in large quantities '(Bar-Yosef 1989:170; see also Reese 1982, 1991). At both Ksar Akil and Üçağızlı molluscs include edible and decorative species (van Regtern Altena 1962; Inizan and Gaillard 1978).

Many of the dentalia from Fazael X are minute cut beads (Goring-Morris 1980a). In addition to other species representing the various natural habitats near Ohalo II 159 *Dentalium* beads were also found (Nadel 1997a; Mienis personal communication).

Taphonomic Research

The following examples of taphonomic studies illustrate their potential for better understanding of archaeological contexts.

Carnivore habitation in caves

Large carnivores, particularly species known to use caves as lairs, like hyena, are present in most Levantine Upper Palaeolithic sites (Table 4.2; Kurten 1965). Still, a few large carnivore remains in cave sites does not necessarily

indicate an active role in faunal accumulations. Distinction between faunal assemblages deriving from human versus carnivore agencies is difficult to accomplish. We can only roughly estimate the intensity of this 'intercalation' of humans and carnivores, as little information on bone modification (the main criterion for the above distinction) is available. However, it does appear that the phenomenon of such intercalation fades away by the beginning of the Epipalaeolithic.

At Ksar Akil the three largest carnivores, brown bear, leopard and spotted hyena, are more common in the earlier parts of the Upper Palaeolithic, although such is not the case at Qafzeh or at Kebara (Bar-Yosef 2000:113; Bar-Yosef *et al*. 1996). It has been suggested that Qafzeh served periodically as a hyena den based on the presence of spotted hyena (*Crocuta crocuta*) cubs (Dayan 1989). Carnivore bone modification, although not very frequent (4%), clearly indicated carnivore access to animal bones. Thus the site provides an interesting case of alternating human and carnivore activities. Two scenarios are possible: 1) bone accumulations resulting from sporadic human occupations, interspersed with hyena denning; or 2) long-term human occupation (or repeated visits to the site) with the hyena denning/usage representing isolated events, *i.e.* in Layers 8 and 5 (Rabinovich 1998a).

Layer 8 has relatively more animal remains, although microfaunal species are rare, being limited to frogs and very small rodents living around the cave entrance rather than originating from nesting birds of prey (Haas 1972). A few bones with cut-marks were present in this layer, as well as burnt bones. Body part distributions indicate few remains in each category, with a slight tendency toward upper hind limbs of fallow deer, but a more even distribution for gazelle. Splinters represent the bulk of the material. In this layer (8) cranial parts of the larger species such as aurochs, equids and cervids are scarce, while gazelle is represented by both cranial and postcranial elements. The other layers display similar body part distributions, indicating no preference for cranial parts by body size. If indeed spotted hyenas do not introduce many bones to their dens (Mills 1990), it might be concluded that at least some of the animal bones from Layer 8 represent remains of a hyena den. Thus the flint industry would have accumulated independently of at least part of the faunal assemblage.

The indices of carnivore modified bones per layer at Upper Palaeolithic Kebara are much higher than those at Qafzeh (Speth, in Bar-Yosef *et al*. 1992: Table 3). Both cubs and mature hyenas (spotted and striped) were found in the Mousterian and Upper Palaeolithic layers of Kebara, and it was concluded that humans were the primary agents of faunal accumulation there. However, such is not the case in Upper Palaeolithic Qafzeh.

The accumulation processes at Qafzeh can thus be interpreted as sporadic, intercalating human occupations, interspersed with occasional hyena denning. Human occupation is more marked in Layers 9–9b, while Layer 8 was occupied by both humans and hyenas, and Layer 5 mainly by hyenas. Overall, neither agent made very intensive use of the cave, but both left their imprints on the material remains.

Butchery patterns and intra-site activities

A detailed faunal study (Rabinovich 1998a) was integrated with the spatial distribution patterns previously recognized in the Aurignacian Layer D at Hayonim Cave (Belfer-Cohen 1980; Belfer Cohen and Bar-Yosef 1981). Gazelle is the main prey consumed, apparently processed on-site in a methodical manner as inferred by body part distributions and locations of cut-marks (Rabinovich *et al*. 1997). The methodical manner of exploitation may portray a 'consumption station', where food was processed and shared leading to accumulation of the 'kitchen midden' (see Enloe 1993). Other larger species were brought in occasionally, often as portions of carcasses. Whether these were leftovers from kill sites (Bartram 1993; O'Connell *et al*. 1988, 1990), chunks shared with other groups (Marshall 1994), or residues from other consumers (*i.e.*, carnivores) is hard to tell. The presence of cut-marks on various elements of the less common species (*e.g.*, aurochs, red deer, wild goat) could indicate that disarticulation was performed elsewhere, perhaps implying sharing with other groups, who kept the rest of the carcass (*i.e*., the carcass was portioned amongst several groups).

Following the archaeological interpretations, more cut-marks and other human modifications were expected in Layers D1/2 and D3, when the 'kitchen midden' was active, as opposed to more animal modifications expected in the less intensively occupied Layer D4. However, when all of the variables were examined, the relative frequency of burnt bones did not differ from layer to layer, nor did the relative modifications by either animals or humans. The similarity of the butchery process between the sub-layers of Hayonim D and the repetitive methodical exploitation may indicate a group tradition in terms of animal exploitation patterns. The tasks performed within the cave did not change much through the course of the occupation. Animal processing was a major activity in the cave during the Upper Palaeolithic. However, whether consumption was local, family-based, or on a much larger scale is difficult to evaluate.

Thus it seems that Hayonim D was occupied by either a small group of hunter-gatherers engaged in intensive activities over a small area for a long duration or, a larger group engaged in intensive activities over a short period of time. As variations do exist between the sub-layers of Hayonim D it can be assumed that most meat consumption took place on a small group basis, processing the meat in the same manner over a long period of time[4].

Discussion

Animal residues represent only a part of human subsistence patterns. Ethnographic studies indicate that vegetal resources would have likely comprised some 50-60% of the diet in the Levantine Mediterranean zone (see Kelly 1995). Edible plant resources in the area would have been both plentiful and reliable, even if availability fluctuated seasonally. Unfortunately plant material is rarely preserved in Upper Palaeolithic contexts. An exception is Late Upper Palaeolithic/Early Epipalaeolithic Ohalo II, which provides excellent and unique evidence of plant subsistence strategies (Kislev *et al*. 1992).

Lithic assemblages form the basis for assignment to specific industries or cultures, and supplementary material remains (*e.g.*, art objects, botanical and faunal assemblages) are ancillary. Thus the faunal studies discussed above do not directly contribute to clarifying ongoing debates on cultural definitions, *e.g.* Bar-Yosef and Belfer-Cohen (1996) *vs.* Gilead (1991).

Marked regional differences in faunal assemblages are apparent (see Table 4.1). Northern assemblages comprise more species, more bones, and mostly derive from cave sites. The dominance of either *Dama* or *Gazella* is notable in Mediterranean settings, whereas in more arid areas a mix of gazelle (*Gazella dorcas*, or *Gazella subgutturosa*), wild ass (*Equus asinus*/*hemionus*), caprines, ostrich and tortoise is characteristic. Looking at the NISPs discrepancies between assemblages makes relative frequency comparisons problematic.

Comparison of the Number of Taxa[5] and NISP (after Grayson 1991) has shown that the major factor involved is sample size: taxonomic richness is higher in larger samples (Fig. 4.2). Some regional correlations do occur since sample sizes are smaller in more marginal areas.

For the majority of Upper Palaeolithic sites most species in the faunal record are territorial, with seasonal changes of herd size, age and sex structure. Occupations generally appear to reflect small bands of hunter-gatherer practicing flexible residential mobility, *i.e*., foragers, as opposed to collectors (Binford 1978). No direct material evidence of food storage is documented, although meat drying and storage of animal fat are feasible processing strategies. Overkill probably was not a problem proir to the Natufian (Tchernov 1993).

The archaeological data concerning occupation intensities do not always correlate with conclusions drawn from the faunal assemblages[6]. The long Upper Palaeolithic sequence of Ksar Akil is unique, indicating prolonged, repetitive use of that site. Human occupation of Kebara Cave was also intense and prolonged. By contrast, Hayonim Cave D differs, with both archaeological and faunal evidence indicating occupation by a group practicing collector-type mobility. The Ahmarian of Qafzeh reflects successive, low intensity foraging stations, thus enabling carnivore use of the cave in the interim. Ohalo II also has characteristics of collectors from various archaeological perspectives (Rabinovich 1998a). The other Jordan Valley sites illustrate the problems outlined in the introduction. The faunal reports describe small samples, albeit characteristic of the Upper Palaeolithic (*i.e.*, gazelle dominance, *ca.* 30% young specimens, *etc*.), which enable only basic interpretations (*e.g.* species and age distribution)[7]. Given the nature of investigations in the Judean Desert it is hard to reconstruct the nature of occupations there, but most were probably foraging stations. Task-specific sites are probably characteristic in more peripheral areas (*i.e.*, Transjordan, the Negev and Sinai) perhaps reflecting greater seasonal mobility.

When examining faunal residues the possibility of subsequent carnivore modification of human-generated residues should also be considered. Carnivore remains comprise *ca*. 2–5% of total NISPs (Table 4.2), except at Qafzeh (12%), where the carnivore to ungulate ratio is also high in comparison to all other assemblages. Fox comprises the largest carnivore group (50–78%), followed by wild cats. Neither of the species are major faunal accumulators or destructive agents.

Cranial parts were never abundant in assemblages, although body part frequencies do differ between species. In several occupations (*e.g.*, Hayonim, el-Wad, Kebara) gazelle were brought in almost intact, while other species were introduced as select portions (Ohalo II being an example of the latter). Kebara and Qafzeh are the only instances where carnivore activities significantly influenced faunal assemblages. Interestingly, these are the only two Levantine Upper Palaeolithic sites where detailed taphonomic studies have been conducted.

Animal exploitation patterns can be examined according to modes of procurement. Common techniques of harvesting faunal resources include:

Hunting	–	medium to large-sized mammals;
Foraging	–	reptiles, amphibia, crustacea, rodents and insectivores;
Trapping	–	hares and small-sized carnivores;
Netting	–	birds;
Fishing	–	fish;

Unfortunately, investigation of diachronic and synchronic changes, as has been conducted for Levantine Neolithic animal exploitation according to phytogeographic zones, is much more complex for the Palaeolithic (Horwitz and Tchernov 1998). It can only be stated positively that the main Upper Palaeolithic hunted prey were medium to large-sized mammals, *i.e*., gazelle and fallow deer. The gazelle, which often makes up a substantial part of hunter-gatherer meat diets is usually consumed rapidly following acquisition (Yellen 1991a, b, < 25 kg.). By contrast the fallow deer is a larger animal (*ca.* 30–50 kg.), which was probably dismembered before being transported to the sites.

Evidence for foraging, trapping, netting and fishing of smaller species is sporadic. The importance of small animal species as food resources due to their remarkable resilience was suggested from at least the Middle Palaeo-

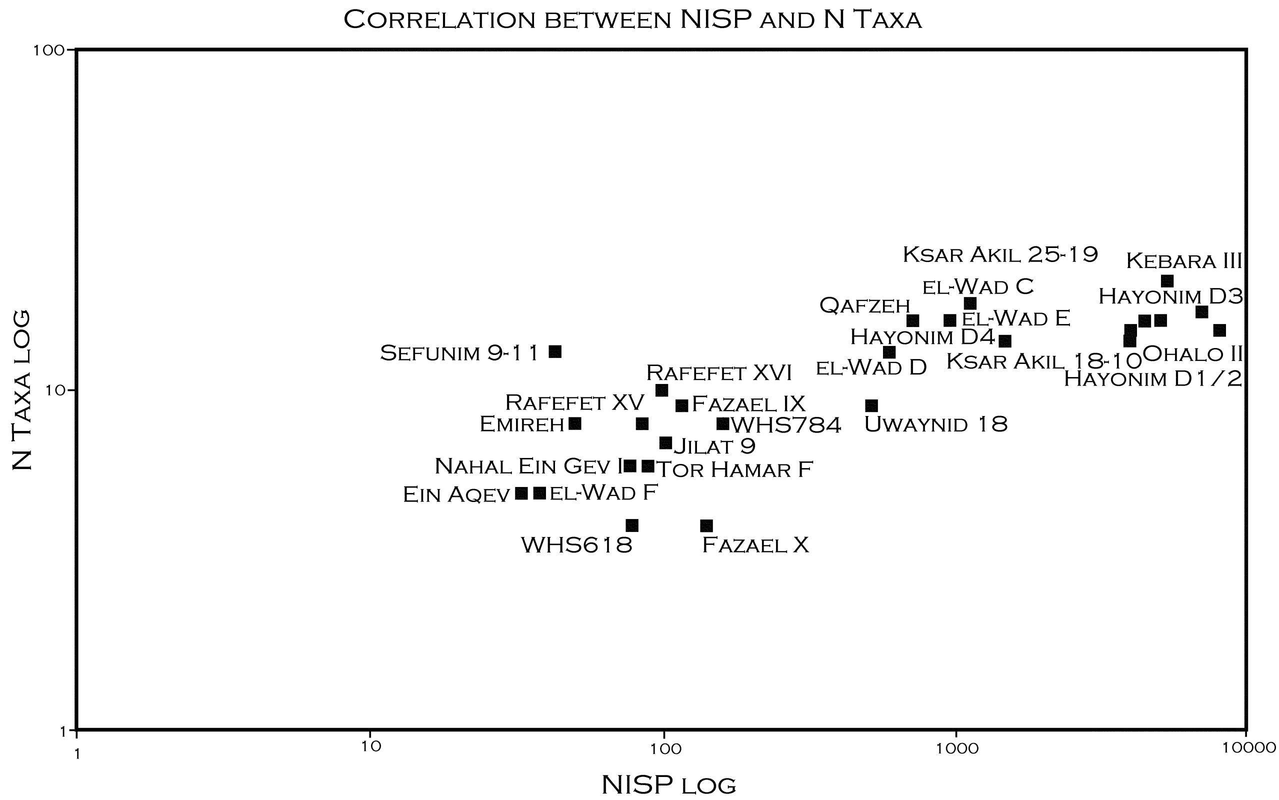

Fig. 4.2 Correlation between the number of taxa (N Taxa log) and the NISP log. Data based on Tables 4.1 and 4.2.

lithic (Stiner *et al*. 1999, 2000). However, the situation is complex in the absence of other similar systematic studies of pre-Natufian assemblages. Procurement of molluscs, even over considerable distances, had more to do with group identities and decoration than with consumption. Possible evidence of netting and fishing at the Late Upper Palaeolithic/Early Epipalaeolithic site of Ohalo II may hint that these technologies already existed but were not preserved earlier in the archaeological record (Nadel *et al*.1994).

Different sex and age distributions between artiodactyl species can result from several possible reasons, since modes of reproduction and season of birth may determine such variability in faunal assemblages. In the Mediterranean zone today the mating season for most artiodactyls is during the autumn-early winter, while the breeding season is in the spring-early summer. For each species the female to male ratio and the age cohorts change according to population structure, mating habits and number of newborns. Based on this data, winter use is favoured for many Upper Palaeolithic sites (Davis 1983; Garrard 1980; Klein 1995b). The presence of diversified age classes (*i.e.*, fawns up to one year, yearlings and older specimens) for various species indicates multi-seasonal use of sites, as at Hayonim D and Ohalo II (Rabinovich 1998a). The relative frequencies of young specimens for the most common species (gazelle and fallow deer) fluctuate *ca*. 30%. Thus the data generally confirm the assumption that '… gazelle breeding patterns have remained constant through the Mousterian-Natufian' (Davis 1983:61).

Cementum-increment analysis of teeth was used to reconstruct seasonality, circumventing possible changes in reproductive behaviour, but adequate sample sizes are needed. The seasonality for several Upper Palaeolithic sites was investigated through studies of gazelle teeth (Lieberman 1993a, b, 1995). El-Wad D was interpreted as an autumn and/or winter occupation, Kebara I–IV as a spring site, Hayonim D was occupied in autumn/winter, and Ohalo II in winter/spring. Winter occupation was suggested also for the Fazael sites. In more arid areas Tor Hamar was interpreted as a winter occupation, while the south Sinai Abu Noshra sites were occupied in early spring.

The age profiles of Dama were reconstructed based on the dental crown heights of teeth from Kebara and Hayonim (Wolf 1988). The results generally resemble those of other analyses (Kebara - Speth in Bar Yosef *et al.* 1992; Hayonim D - Rabinovich 1998a, b), indicating that hunting strategies focused on all age groups[8]. Differences were noted between the assemblages of Ksar Akil Phases I and II–III (Bergman's phases, Bergman 1987) with those of the latter resembling the age profiles of Kebara and Hayonim. A change in hunting technology during Phase II (levels 20–16) may have enabled increased access to prime-age members.

A phenomenon that has been observed in most sites for

one of the less common species, the boar (*Sus scrofa*), is that although the number of boars in the assemblages is quite small, there was a tendency to capture young specimens.

Faunal remains from communal hunting should reflect the characteristics of herd composition, whether the age and sex profiles of bachelor herds, or harems. However, no Upper Palaeolithic – pre-Natufian Epipalaeolithic faunal assemblages reflect such patterns. It can thus be deduced that communal hunting was not practiced in the Levantine Upper Palaeolithic and earlier Epipalaeolithic. Rather, the most likely scenario involved targeting the most available local species (Higgs 1967).

Use of non-selective hunting methods (*i.e.*, by traps, nets, drives) would cause catastrophic age profiles. Yet, gazelle remains (the most common prey) in Upper Palaeolithic assemblages reflect selective methods of hunting. Thus hunters were more likely to focus on young adults and adults (targeting larger specimens). Male dominance in most assemblages is related to vulnerability when guarding territory, reducing flight distance (Baharav 1983). Since we do not know the past behavioural characteristics of mountain gazelle, caution should be practiced in interpreting seasonality of occupations based on the age structures of ungulates. If the timing of births and the ability of lactating female ungulates to conceive depend on short-term adaptations to changing environmental conditions, it will be difficult to reconstruct prehistoric birth-rates, and several scenarios are possible (Horwitz *et al*. 1990). If environmental changes were rapid (*e.g*., decadal), it would then be impossible to evaluate seasonality based on aging gazelles from specific site layers.

Burnt bones of various species and their intra-site spatial distributions can also provide insights about subsistence practices. For example, at Kebara bones of the more common species are relatively more burnt, in contrast to the situation at Hayonim where the opposite is true. It is plausible to suggest that the less abundant species were brought into the site as fuel material from the very beginning. This reflects a range of attitudes and pre-planning. However, varied cooking, roasting, and heating techniques could completely change our current interpretations (Gifford-Gonzales 1989; Jones 1993). Chunks of meat and fat could have been cooked in hearths, whether alone, wrapped in leaves, or with other perishable utensils, even without the use of formal cooking tools.

Summary

Why are Upper Palaeolithic sites so varied? It is tempting to suggest that the span of 25,000 years in varied geographical niches accounts for such variability. The transition from the Middle to the Upper Palaeolithic is considered a '… true technological and cultural revolution' (Bar-Yosef 1998:152). Improved subsistence strategies and new technologies, such as spear-throwers and the earliest archery, may appear during the Early Upper Paleolithic (*ibid*.; Bergman and Newcomer 1983). The faunal record does not appear to be abruptly divided, though only a few late Mousterian sites were studied in sufficient detail to permit comparisons. The shift from large species to the dominance of gazelle and fallow deer probably occurred already in the late Mousterian (*e.g.*, Kebara, el-Wad, and Amud - Speth and Tchernov 1998; Garrard 1980, 1982; personal observation). Already Bouchud (1974) emphasized the difference between the Middle Palaeolithic and the Upper Palaeolithic assemblages in Qafzeh, where cervids decreased, correlating this change in species distribution to the onset of drier climatic conditions.

Species distributions for the earlier Epipalaeolithic are similar to Upper Palaeolithic patterns, with an increasing dominance of gazelle in most sites (Bar-Oz 1996; Davis 1982, 1983; Hovers *et al*. 1988; Tchernov 1981, 1988). Upper Palaeolithic bands were small with high residential mobility (foragers). By contrast, it has been suggested, based on environmental reconstruction and theoretical considerations, that earlier Epipalaeolithic groups practiced logistical mobility and longer periods of site occupation (collectors), *e.g.*, Urkan e-Rub IIa (Hovers 1989; Hovers and Marder 1991; Kaufman 1992). The available information indicates a trend at the end of the Upper Palaeolithic/Early Epipalaeolithic of increased evidence for fishing, netting and exchange networks[9].

Much more problematic are endeavours to comprehend differences between faunal assemblages deriving from different cultural complexes (*i.e*., Ahmarian, Levantine Aurignacian). Since the 'Two Tradition' framework is debatable (Belfer-Cohen and Bar-Yosef 1999), additional approaches should be employed in order to evaluate individual assemblages. These include the range of species exploited, the culling of certain species, the presence/absence of exotic species; and the intensity and modes of butchery. Additionally, the presence/absence of carnivore activities should be evaluated. Finally, other non-dietary aspects of the faunal remains, such as mollusc exchange and the use of bone and antler as raw materials can provide significant insights into cultural developments during the course of the Upper Palaeolithic.

Acknowledgments

I wish to thank Anna Belfer-Cohen and Nigel Goring-Morris for inviting me to participate in this volume. They helped in all aspects and were very patient. Without them it would have never ended. A special note of thanks is due to John Speth for providing previously unpublished data from Kebara Cave.

Table 4.1 The composition of Upper Palaeolithic faunal assemblages (major species). Key: x = species present, no data; NISP, number of bones (all numbers are percentages of the NISP).

	Gazelle	Dama	Cervus	Capreo	Cervid	Alcel	Ov/Ca	Sus	Equus	E.he	E. hy	Rhino	Bos	Cam	NISP	References
MOUNT LEBANON																
Abu Halka IVf	x	x	x	x				x	x				x			Garrard 1980, Table 5:Y, Haas in Haller 1942–43
Abu Halka IVe	x	x	x	x				x					x			Garrard 1980, Table 5:Y
Abu Halka IVd		x		x												Garrard 1980, Table 5:Y
Abu Halka IVc	x	x	x	x			x	x					x			Garrard 1980, Table 5:Y
Ksar Akil 25–19	1.30	61.50	4.00	4.30			25.60		0.00				3.40		**4000**	Garrard 1980, Table 5:Y
Ksar Akil 18–10	3.00	49.00	0.03	24.51		0.03	20.74						2.32		**3958**	Garrard 1980, Table 5:Y
Ksar Akil 9–6	2.04	41.27	0.13	31.69		0.02	24.78		0.04				0.02		**4468**	Garrard 1980, Table 5:Y
El-Bezez A	40	60													**10**	Garrard 1980, Table 5:Y
Antelias	x	x	x	x		x	x	x	x				x			Garrard 1980, Table 5:Y
Yabrud II							x		x							Lehman 1970
Yabrud III							x		x							Lehman 1970
ISRAEL (NORTH)																
El-Wad F		23.68	26.32				10.53	2.63					36.84		**38**	Garrard 1980, after Table 5:D; Kurten 1965
El-Wad E	13.49	63.06	6.64	0.21		1.66	0.93	1.24		0.21			10.69		**964**	Garrard 1980, after Table 5:D; Kurten 1965
El-Wad D	56.27	24.12	4.19	0.17		1.68	1.84	2.18		0.67			6.87		**597**	Garrard 1980, after Table 5:D; Kurten 1965
El-Wad C	69.61	10.04	0.71	0.80		0.98	4.18	1.33	1.42	0.18	0.53		6.13		**1125**	Garrard 1980, after Table 5:D; Kurten 1965
Sefunim (9–11)	6.98	23.26	9.30	9.30		4.65	18.60	4.65					9.30		**43**	Tchernov 1984b
Rakefet B-G 18–23 XVI	45.6	22.2	12.1				2	12				2.4	4		**99**	Garrard 1980 Table 5L
Rakefet B-G 18–23 XV	29.4	54	7.1	x				3.5							**85**	Garrard 1980 Table 5L
Rakefet B-G 18–23 XIV	64	36													**14**	Garrard 1980 Table 5L
Kebara III	45.00	34.30	1.54	0.43		0.02	0.11	0.51	0.04				0.96		**5335**	Speth per.comm; Bar-El and Tchernov 2001
Hayonim D4	51.59	6.09	1.83	0.68	0.34		0.54	0.34				0.07	0.54		**1479**	Rabinovich 1998a
Hayonim D3	42.87	4.41	1.38	0.61	0.43	0.10	0.84	0.31	0.03				0.43		**7012**	Rabinovich 1998a
Hayonim D1/2	48.93	7.86	2.21	0.47	0.32	0.10	0.71	0.49	0.02				0.77		**5077**	Rabinovich 1998a
Qafzeh	19.55	7.96	6.01	0.70			2.09	2.09	0.70				4.05		**716**	Rabinovich 1998a
JORDAN VALLEY (NORTH TO SOUTH)																
Emireh	x		x				x		x			x	x	x	**ca.50**	Bate 1927
Nahal Ein Gev I	41.56	15.58	32.47				3.90		5.19				1.30		**77**	Davis 1982, Table 2
Ohalo II	25.39	5.09	0.14		0.17		0.05	0.23					0.02		**8111**	Rabinovich 1998a, Simmons and Nadel 1998
Fazael IX	70.69	18.10	0.86	1.72		0.86	5.17	0.86					1.72		**116**	Davis 1982, Table 2
Fazael XI	54.55	36.36					9.09								**11**	Davis 1982, Table 2
Fazael X	88.57	10.71						0.71							**140**	Davis 1982, Table 2

Table 4.1 continued

	Gazelle	Dama	Cervus	Capreo	Cervid	Alcel	Ov/Ca	Sus	Equus cf. *mauritanicus*	E.he	E. hy	Rhino	Bos	Cam	NISP	References
JUDEAN DESERT																
Erq el-Ahmar F	x		x				x		x							Vaufrey 1951
Erq el-Ahmar E	x		x			x	x		x			x				Vaufrey 1951
Erq el-Ahmar D	x		x				x		x			x				Vaufrey 1951
Erq el-Ahmar C	x						x		x			x				Vaufrey 1951
Erq el-Ahmar B	x						x	x	x			x				Vaufrey 1951
El-Quseir C	many		x				x(ibex)	x	x							Perrot 1955
El-Quseir D			x													Perrot 1955
Masraq e-Naj	many	x	many						x small							Perrot 1955
NEGEV AND SINAI																
Ain Aqev (D31)	39.39						36.36		15.15						**33**	Tchernov 1976
Boqer (D100)									x(asinus)							Davis 1982, Table 2
Abu Noshra I	x						x	x	x							Phillips 1988
Abu Noshra II	x						x		x				x			Phillips 1988
Lagama X																Gilead 1977
TRANSJORDAN																
Jilat 9	2								11						**102**	Garrard *et al*. 1988, Martin 1994
Uwaynid 18	83.2						0.2		14.1				1	0.2	**518**	Garrard 1998a, b Table 1; Martin 1999, Table 5, 6; Reese 1995
Uwaynid 14	54.5								9.1				9.1		**11**	Garrard, 1998 Table 1; Martin, 1999, Table 5, 6
WHS 618							1.35		71.7				25.6		**78**	Clark *et al*. 2000:34
WHS 784	63.1						1.28		14.4		1.28		2.5		**160**	Clark *et al*. 2000:38, Table 2.22
Tor Hamar F	65						15		5						**88**	Klein 1995b, Table 20.1
Tor Hamar G							100								**2**	Klein 1995b, Table 20.1

Table 4.2 Upper Palaeolithic faunal assemblages (carnivores, and others). Key: x = species present; NISP, number of bones (all numbers are percentages of the NISP). References as for Table 4.1.

	Proc	Hyst	Lep	Carn	Ursus	Pant	F. leo	Crocu	Hyen	F. silv	F. chau	F. sp	F.car	Canis	C.lup	C.aur	Vulp	Mart	Meles	Vorm	Aves	Testud	Mollus	Fish	N ID	NISP
MOUNT LEBANON																										
Abu Halka IVf												x		x							x	x				
Abu Halka IVe												x					x					x				
Abu Halka IVd																										
Abu Halka IVc										x																
Ksar Akil 25-19		x			x	x		x		x					x		x		x		x					**4000**
Ksar Akil 18-10					x	x				x	x				x		x	x			x					**3958**
Ksar Akil 9-6					x	x				x						x	x	x	x		x					**4468**
El-Bezez A																					x	x				**10**
Antelias			x		x					x	x						x	x								
ISRAEL (NORTH)																										
El-Wad F																										**38**
El-Wad E	0.42	0.21	1.14			x		0.10										x	x							**964**
El-Wad D	0.67		1.34															x	x							**597**
El-Wad C	0.09		1.51		0.09	0.09		0.26		0.36					0.18		1.07	0.44								**1125**
Sefunim (9-11)			4.65				2.33			2.33						2.33		2.33								**43**
Rakefet B-G 18-23 XVI						1		1														x				**99**
Rakefet B-G 18-23 XV						1.2				1.2							1.2					x				**85**
Rakefet B-G 18-23 XIV																					x					**14**
Kebara			0.90	0.04		0.21			0.58	0.49	0.24	0.24		0.02		0.09	1.78	0.36	0.22	0.07	4.48	x			6.97	**5335**
Hayonim D4			0.20							0.41							1.28	0.07			x	x				**1479**
Hayonim D3			0.13						0.01	0.40						0.01	1.28	0.03			x	x				**7012**
Hayonim D1/2			0.20							0.65							0.75	0.04		0.02	x	x				**5077**
Qafzeh				0.42		0.14	0.28	4.05	0.42							0.42	0.98			0.14					4.75	**716**
JORDAN VALLEY (NORTH TO SOUTH)																										
Emireh			x																							**ca.50**
Nahal EG I																										**77**
Fazael IX																							x			**116**
Ohalo II			0.95	0.15					0.02	0.22							1.45				6.02	x	x	x	0.68	**8111**
Fazael XI																							x			**11**
Fazael X																							x			**140**

Table 4.2 continued.

	Proc	Hyst	Lep	Carn	Ursus	Pant	F. leo	Croc	Hyen	F. silv	F. cha	F. sp	F.car	Canis	C.lup	C.aur	Vulp	Mart	Meles	Mellio	Aves	Testud	Mollus	Fish	N ID	NISP
JUDEAN DESERT																										
Erq el-Ahmar F																										
Erq el-Ahmar E						x														x						
Erq el-Ahmar D					x				x																	
Erq el-Ahmar C									x (spelaea)																	
Erq el-Ahmar B	x																x									
El-Quseir C													x										x			
El-Quseir D																							x			
Masraq e-Naj																							x			
NEGEV AND SINAI																										
Ain Aqev (D31)			9.09																		15.15					**33**
Boker (D100)																										
Abu Noshra I												x					x									
Abu Noshra II												x			x						x			x		
Lagama X																					x(ostrich eggshell 82 dentalium					

	Proc	Hyst	Lep	Carn	Ursus	Pant	F. leo	Croc	Hyen	F. silv	F. cha	F. sp	F.car	Canis	C.lup	C.aur	Vulp	Mart	Meles	Vorm	Aves	Testud	Mollus	Fish	N ID	NISP
TRANSJORDAN																										
Jilat 9			1																			87.00				**102**
Uwaynid 18			1	0.2																	0.2	x	x			**518**
Uwaynid 14			18.2																			9.10				**11**
WHS 618																						1.35				**78**
WHS 784																					0.625	14.38		1.28		**160**
Tor Hamar F																1.00					1.00	1.00				**88**
Tor Hamar G																										**2**

List of Abbreviations

Gazelle	–	Gazelles – for the exact species see text
Dama	–	*Dama mesopotamica*, fallow deer
Cervus	–	*Cervus elaphus*, red deer
Capreo	–	*Capreolus capreolus*, roe deer
Cervid	–	Cervid, unidentified
Alcel	–	*Alcelaphus buselaphus*, hartebeest
Ov/Ca	–	Caprini, *Capra aegagrus*, *Capra ibex*, *Ovis* sp.
Sus	–	*Sus scrofa*, boar
Equus	–	*Equus* sp. *Equus caballus*
E. he	–	*Equus hemionus*/*asinus* – wild ass
E. hy	–	*Equus hydruntinus*
Rhino	–	*Rhinoceros hemitoechus*, rhinoceros
Bos	–	*Bos primigenius*, aurochs
Cam	–	*Camelus* sp, camel
Proc	–	*Procavia capensis*, hyrax
Hyst	–	*Hystrix indica*, porcupine
Lep	–	*Lepus capensis*, hare
Carn	–	Carnivore, unidentified
Ursus	–	*Ursus* sp., bear
Pant	–	*Panthera pardus*, leopard
F.leo	–	*Felis leo*, lion
Croc	–	*Crocuta crocuta*, spotted hyena
Hye	–	*Hyeana hyeana*, striped hyeana
F.silv	–	*Felis silvestris*, wild cat
F.cha	–	*Felis chaus*, jungle cat
F.sp	–	*Felis* sp.
F.car	–	*Felis caracal*, caracal lynx
Canis	–	*Canis* sp.
C.lup	–	*Canis lupus*, wolf
C.aur	–	*Canis aureus*, jackal
Vulp	–	*Vulpes vulpes*, red fox
Mart	–	*Martes foina*, stone marten
Meles	–	*Meles meles*, common badger
Melliov	–	*Melliovora capensis*, honey badger
Vorm	–	*Vormela peregusna*, marbled polecat
Aves	–	Aves species, see details in text
Testud	–	*Testudo*, tortoises
Mollus	–	Molluscs, various species, see text
Fish	–	Various species
NID	–	Unidentifiable

Body size groups were not included in the table as they are available only for a few sites (Hayonim, Qafzeh, Ohalo II and Kebara, NISP including body size groups).

BSGA	–	Aurochs (*Bos primigenius*) size (> 1000 kg.)
BSGB	–	Fallow deer (*Dama mesopotamica*), red deer (*Cervus elaphus*), wild boar (*Sus scrofa*), hartebeest (*Alcelaphus buselaphus*) size (80–250 kg.)
BSGC	–	Wild goat (*Capra aegagrus*) size (40–80 kg.)
BSGD	–	Gazelle (*Gazella gazella*), roe deer (*Capreolus capreolus*) size (15–40 kg.)
BSGE	–	Hare (*Lepus capensis*), common red fox (*Vulpes*) size (2–7 kg.)
NISP	–	Number of Identified Specimens

Notes

1 Common English names of the animals and their Latin names were used interchangeably, though they generally follow the terms used by the authors of site reports (see list of abbreviations).

2 The Kebara results do not include the new series of excavations (1982–1990).

3 Another suggestion includes magic and erotic uses: 'Sólo contados ejemplares (Dentalium, Columbella), sirvieron como objectos de adorno y muy posiblemente algunos de ellos tuvieron un destino magico o erotico.' (Madariaga 1966:170).

4 Dealing with the notion of 'time' is beyond the scope of this paper.

5 As reflecting taxonomic richness.

6 For example at Late Upper Palaeolithic Jilat 9 in eastern Jordan there seems to be no correlation between the interpretation provided by the fauna and the archaeological interpretation of the site as a palimpsest of occupations (Byrd 1988 vs. Martin 1994:447).

7 It is thus not possible to pinpoint the faunal taphonomic characteristics. Further excavations and taphonomic studies are required.

8 Though suggesting greater targeting of young adults.

9 For the northern Levant Ksar Akil is one of the only sites available, not necessarily reflecting others. The analysis of the Epipalaeolithic levels (Levels I–V) suggested a possible change in butchery methods in Levels IV–V (Kersten 1989a, b).

5. Generating the Middle to Upper Palaeolithic Transition: A *Chaîne Opératoire* Approach

Michael Chazan

'In my experience, the idea of unilinear progress does not survive serious engagement with the detail of the history of technology. For what is perhaps most striking about that history is its wealth, complexity, and variety. Instead of one predetermined path of advance, there is typically a constant turmoil of concepts, plans, and projects. From that turmoil, order (sometimes) emerges, and its emergence is of course what lends credibility to the notions of 'progress' or 'natural trajectory.' With hindsight, the technology that succeeds usually does look like the best or the most natural next step.' (MacKenzie 1996:6)

Introduction

Over the past twenty years the revised taxonomy of Levantine and North African fossils along with the discoveries at Klasies River Mouth have convincingly ruptured the link between the origin of modern humans and the origin of the Upper Palaeolithic (Stringer and Andrews 1988). Paradoxically, at the same time an explanation of the origin of the Upper Palaeolithic in terms of the emergence of the cognitive capacity for language has developed and become widely accepted. The 'language hypothesis' was first clearly articulated in a series of articles by P. Mellars based on the European evidence (Mellars 1989). Explanations of the Middle to Upper Palaeolithic transition have since shifted to the concept of modern human neural capacities (expressed in terms of 'modern human behaviour') championed by R. Klein, based on a consideration of global patterns of change in the period around 40,000 bp (Klein 1992, 1995a). According to this hypothesis the origin of modern behaviour post-dated the origin of anatomically modern humans and resulted in a global transformation of material culture and a sudden replacement of populations throughout the Old World. To arrive at this conclusion Klein links the transformation of culture at the Middle Stone Age/Late Stone Age boundary in Africa with the transformation of culture at the Middle Palaeolithic/Upper Palaeolithic boundary in Europe and the Near East. The recent trend is to see these transformations as chronologically overlapping, with the African transition possibly predating the European (Ambrose 1998a). Similar ideas with different theoretical underpinnings have been proposed by a number of authors (Mithen 1996; Noble and Davidson 1996).

The epistemology of these ideas is surprisingly complex. In part the notion that the European and Near Eastern Upper Palaeolithic represents a cognitive shift is based on ideas that were deeply entrenched before the new information on the chronological position of modern humans in African and the Middle East was available. Already in the 19th century the idea that the appearance of language was a transformative event is found in Darwin and Haeckel (Landau 1991; Radick 1999). Also present is the kind of retroactive thinking, described by MacKenzie in the passage quoted above, which characterizes much of origins research. Origins research selects out of the tumult and chaos of prehistory a small number of critical turning points that are seen as the natural trajectory of human society. Furthermore, these turning points are reconstructed as revolutions that transfigure humanity from one state to another.

The position taken by the 'language hypothesis' is that the human capacity for language had to have developed at some point during the evolutionary history of the species. Given the importance of language to humanity, the appearance of this capacity should map on to a point in the archaeological sequence where we find dramatic change. The Middle to Upper Palaeolithic transition is certainly dramatic and thus fits the bill. Arguments are then made for why the archaeological material supports the identification of the origins of language.

An alternative position is to see the origins of the capacity for language as gradually emerging in the course of hominid evolution with the appearance of new neurological capacity coincident with speciation events. Such a position has the advantage of providing a basis for understanding the success of *Homo erectus* in spreading across much of the old world and developing sophisticated lithic technologies (Gowlett 1984; Gamble 1993). This position also has the advantage of not requiring

an event in the evolution of the neurological basis of human cognition, which has left no evidence in the fossil record.

The goal of this paper is not to attempt to refute the use of a cognitive framework for explaining the Middle to Upper Palaeolithic transition (see Chazan 1995; McBrearty and Brooks 2000). Nor is the goal to set up an alternative explanatory framework (see Gilman 1984; Bar-Yosef 1998a; Jochim 1983; Conkey 1980). The goal is more modestly to attempt to describe the transition from a technological perspective. The Middle to Upper Palaeolithic transition is often presented as a list of seemingly unconnected traits. The search for an underlying principle has led many authors to look towards cognition. In looking at the transition from a technological perspective the goal is not to deny that cognitive change took place but rather to look at cognition in the world rather than exclusively as an expression of brain anatomy (Clark 1997). In this discussion I draw largely on three concepts found in the literature on technology, *chaîne opératoire*, generative technology, and expressive technology. There are other concepts in the technological literature, which are relevant to this topic, notably *tendance* and *fait* (Stiegler 1998): however these are not explored here. This discussion will encompass in very general terms both the classic Western European and Levantine records for the transition.

The *Chaîne Opératoire*

The concept of the *chaîne opératoire* has come to be widely known among prehistoric archaeologists. In the realm of lithic analysis a number of review articles have been written with discussions of the methods and ideas underlying this concept (Boëda 1991; Chazan 1997; Pelegrin 1993; Schlanger 1995a; Sellet 1993). Prehistoric archaeologists have come to think of the *chaîne opératoire* as a fancy version of a reduction sequence. It is widely understood that a *chaîne opératoire* differs from a reduction sequence in that it involves not only the material record of a series of actions but also reconstruction of the conceptual model held by the person carrying out the technical act. Thus the *chaîne opératoire* incorporates a psychological component absent from many reduction sequence analyses.

A broader reading of the literature on the *chaîne opératoire*, particularly work by ethnographers, brings out other facets besides the psychological component. The goal is also to forge a powerful link between the social and technological domains (see White 1997 for an archaeological context). It is interesting that much of this discussion takes place in the context of modern technologies, particularly in the transfer of technology in the contemporary world. An example is found in Robert Cresswell's (1982) influential article '*Transferts de Techniques et Chaînes Opératoires*'. Cresswell writes of a town in the state of Bihar in India where a solar pump was to be installed in order to provide fresh water to a village. Due to delays the local people had time to think through the implications of this project. An attempted murder brought to the project director's attention that there was a problem. The pump was to be placed at the border of two territories, one belonging to the original occupants of the village and the other to relative newcomers. The 'newcomers' had the right to work some marginal lands in exchange for labour. However, the pump would allow for irrigation of these lands that would make them more productive and lead to an equalizing of the political stature of the two groups. The import of this story lies in the villagers' understanding of technology as a process linked to social structure versus the project director's view of technology as objects and capacity. The introduction of a new technology (the pump) would have an impact on existing technologies (irrigation) that would lead to significant social change. The *chaîne opératoire*, by looking at the dynamics of technical processes rather than at technological objects, is able to create a framework that connects the technological with the social.

Generative and Expressive Technologies

Cresswell's article brings up a distinction, clearly grounded in Marxist theory, which is potentially useful in addressing the Middle to Upper Palaeolithic transition. Cresswell differentiates between techniques that *generate* social structure (generative techniques) and techniques that *express* social structure (expressive techniques). Of the generative techniques Cresswell writes that 'the techniques of manufacture and acquisition are integrated with their social relations in such a way that a change in one domain will lead to a change in the other' (Cresswell 1982:146)[1]. Of expressive techniques he writes '… the techniques of consumption (clothing, housing…) express social relations without being able to transform them' (*ibid.*).

Generative Technologies

The European Middle to Upper Palaeolithic transition

From the perspective laid out by Cresswell artwork cannot be seen as the cause of social change. Rather, it is an expression of existing social relations. For a cause for social change we must look to the generative technologies (see also Gilman 1984). In Europe when looking at techniques related to manufacture and acquisition one has three types of evidence. The first relates directly to acquisition in terms of raw material for lithic manufacture and for body adornment. There is evidence for an increase in the distance raw material was transported when the Aurignacian is compared with the Middle Palaeolithic (Blades 1999; Géneste 1988; Roebroeks *et al.* 1988). However, there is no evidence for change in techniques of acquisition such as large-scale quarrying. The only change

is in the distance material was transported or exchanged.

The second line of evidence involves a change in the types of tools used for processing hides and bone. Where the Middle Palaeolithic is characterized by sidescrapers made on flakes, the Aurignacian is characterized by endscrapers and burins made on blades and flakes. Some have argued that this shift relates to changes in standardization or efficiency. However, in the European context, where blades represent a small percentage of the assemblage during the early Upper Palaeolithic, this remains to be supported empirically (Chazan 1995). It is very hard to see the shift from sidescrapers to endscrapers and burins as transformative.

The third line of evidence comes from projectile technology, which displays clear innovations with the introduction of both bone points and microliths (Knecht 1991, 1993). The exact purpose of microliths is unclear, however, following proposals made for the Gravettian, it seems likely that the bladelets found in the Aurignacian were elements in composite points (Chazan in press; Soriano 1998; Lucas 1997). It seems quite plausible that these elements of projectile technology did have the potential to generate social change.

The immediate clamour of objections is evident. We know there were hunting tools during, and even before, the Middle Palaeolithic. The wooden spears from Lower Palaeolithic Schönigen and Mousterian points in general spring to mind (Shea 1988; Thieme 1997). Perhaps even more significant is the lack of any evidence from faunal assemblage for a radical change in subsistence across the Middle to Upper Palaeolithic transition (articles in Burke 2000). Middle Palaeolithic people clearly hunted large game, including occasional large-scale kills. It is no longer possible to talk of the Upper Palaeolithic as the origin of hunting. However, this does not mean that there were not very significant changes in the techniques of hunting at this time. Composite points and bone points have significantly different properties from the types of thrusting spears found in the Middle Palaeolithic. From a *chaîne opératoire* perspective what is critical is that the process of hunting would have changed drastically. This involves a real change in generative techniques that would unavoidably have an impact on social relations.

The Levantine Middle to Upper Palaeolithic Transition

Early Ahmarian lithic industries are dominated by blade production. This method of production represents a rupture with the immediately preceding Middle Palaeolithic traditions and fits within the package of behaviours associated with the Upper Palaeolithic. Such a generalization is contradicted by the documentation of blade industries in Middle Palaeolithic contexts in Europe and the Near East and Middle Stone Age contexts in Africa (Révillion and Touffreau 1994, McBrearty and Brooks 2000). Perhaps more importantly the label 'Upper Palaeolithic blade manufacture' does not refer to a homogenous phenomenon. As discussed above, for the European Early Upper Palaeolithic blade production refers to the production of a low percentage (<15%) of large blades, though the bulk of production is of flakes that are often retouched. Blade production in the European context is associated with burin and endscraper dominated assemblages (Chazan 1995).

Early Ahmarian blade production is starkly different. The percentage of blades produced often reaches an incredible 50% and many of the blades are thin and narrow. Blade production is associated with marginally retouched blades and points rather than endscrapers and burins. The technology of Early Ahmarian blade production is the subject of several contributions to this volume. It seems clear that in the Early Ahmarian a soft hammer was used for detaching blades.

The argument that Early Ahmarian lithic production had advantages in terms of efficiency and standardization over preceding methods of manufacture cannot easily be dismissed. It remains difficult to see how these advantages would have articulated with social structures in such a way as to have a significant impact. One difference between pieces produced by soft and hard hammer is that soft hammer flakes lack a pronounced bulb of percussion and therefore have a more regular longitudinal profile. It is interesting that it is exactly this feature that is mimicked by the basal thinning characteristic of Emireh points. It seems likely (although as yet untested) that this feature would alter the aerodynamic properties of blades on projectile points.

Thus when looking for change in generative technologies in the Near East we can suggest that the situation is quite similar to what is found in Europe. In both the Levant and Europe the beginning of the Upper Palaeolithic is marked by significant change in the technology of hunting as reflected in the nature of projectile points. These changes are the only changes that fit well within the category of generative technology as defined by Cresswell.

Expressive Technologies

The hallmark of the European Middle to Upper Palaeolithic transition is the appearance of highly sophisticated works including cave paintings at Chauvet Cave, mobile art from Geissenklösterle, Hohlenstein-Stadel, and Vogelherd, and various types of body adornment in the early stages of the Aurignacian (Bosinski 1990; Chauvet *et al.* 1996; White 1997). However we interpret these objects, they are fundamentally technical, the products of a sequence of human actions on the material world. It is important to keep in mind the breadth of the technical world as indicated by M. Mauss' term *'les techniques du corps'* (Schlanger 1998). Following Cresswell it is hard to see these as anything but expressive techniques. While they are stunning and impressive expressions, they are not capable of transforming society. They express the

ideas of a social structure that has already come into being.

However, there is reason to question the concept of expressive techniques as defined by Cresswell. Certainly in historic periods expressive techniques have often led to demand for products that in turn has had a transformative effect on society (Mintz 1985; Wolf 1982). It might be the case that, while in their initial stages expressive techniques do not have a transformative impact, this might not be the case once they are engrained in the technical repertoire. Thus in the case of Upper Palaeolithic art it is quite possible that by the Magdalenian artwork played a critical role in inter-group communication, although there is no evidence that artwork played any such role at the beginning of the Upper Palaeolithic (Conkey 1980).

A more fundamental problem is that Cresswell appears to accept a dichotomy between the reality recognized by western economics and the beliefs that people hold about their world (Wagner 1981). Generative technologies refer to manufacture and acquisition in modern Western terms. This approach by definition excludes from consideration aspects of acquisition and manufacture that would strike us as ‘irrational’. This is a serious shortcoming. Given the fact that the artwork of the Aurignacian is dominated by pieces that either depict the animal world and/or transform the animal world into objects of adornment it would seem quite likely that they indicate practices which would have been integrated into the *chaîne opératoire* of hunting. It is perhaps the case that particularly in hunter/gatherer societies expressive technologies will be tightly integrated with methods of manufacture and acquisition.

There is no indication that the *chaîne opératoire* of hunting in the Ahmarian involved the production and manipulation of artefacts depicting animals or making use of parts of animals. There is certainly evidence for symbolic behaviour in the use of red ochre, incisions on rock, and collecting of shells for both the Mousterian and the Early Ahmarian (Marshack 1997; Bar-Yosef 1997; Kuhn *et al*. 1999, this volume). However, it is not clear how any of these would be integrated with the process of hunting. Artefacts depicting animals and making use of parts of animals do eventually reach the Near East as part of a cultural ensemble which is clearly derived from the European Aurignacian (Belfer-Cohen and Bar-Yosef 1999). The interpretation of the geographical spread of the Aurignacian into the Levant raises complex questions about the significance of migration in prehistory. Setting aside the artistic and ornamental aspects, it does seem that the Aurignacian represents an integrated technological system rather than a collection of disparate elements. The co-occurrence of Dufour bladelets and split-base points indicates a broad spectrum of technological knowledge related to production, hafting, and use (Chazan 2001). Given the particularity of the components of this technological system, it seems extremely unlikely that the appearance of the Aurignacian in the Levant is the result of independent invention. Whether one can invoke a mechanism other than the actual movement of people to explain the spread of a technological system is a question that does not have an obvious resolution.

Constant Turmoil

The Middle to Upper Palaeolithic transition is a complex phenomenon that is amenable to description in terms of technology. Technological analysis, as discussed by McKenzie in the quote above, does not aim at discovering one predetermined path of advance. Rather the goal is to discover order within a constant turmoil of concepts, plans, and projects. The goal of the discussion presented here is not to sweep away the differences between the Early Upper Palaeolithic of the Levant and that of Europe. In Europe stone tool manufacture involved production of a low percentage of blades, a focus on burins and endscrapers, and production of short twisted bladelets. In the Levant stone tool manufacture includes production of a high percentage of blades and a focus on points and marginal retouch. It is possible to argue that the Early Ahmarian methods of production involved significant advantages in terms of standardization and efficiency over preceding periods.

However, underlying these differences is a common theme of innovations in the production of projectile points that would have had an impact on the *chaîne opératoire* of hunting. It is suggested here that these changes fit within the realm of generative technologies capable of transforming social structure.

When comparing the *chaîne opératoire* of hunting for the Early Upper Palaeolithic of the Levant and Europe the presence of artefacts representing animals or making use of animal bones, teeth, antlers and tusks in Europe is striking. It is hard not to believe that the *chaîne opératoire* of hunting in Europe was significantly different at least in terms of how people thought about what they were doing. A number of ethnographic studies have demonstrated that the beliefs held by people do have an impact on the *chaîne opératoire* (Lemonnier 1992).

The Middle to Upper Palaeolithic transition can be seen as part of a long and complex history of experimentation and innovation in both techniques of manufacture and acquisition and symbolic expression that stretches far back into the Middle Palaeolithic. Underlying both of these processes are shifts in the *chaîne opératoire* of hunting. One major factor in the Upper Palaeolithic is the adoption of light projectile points. In Europe the *chaîne opératoire* of hunting comes to include the incorporation of animals into the human domain through the depiction of animals and use of animal material. Why this innovation took place in Europe might be related to demographic, ecological, and/or social factors. It might also be that this pattern reflects factors relating to the preservation of the archaeological record.

Change in cognitive capacity is not the only way to account for the Middle to Upper Palaeolithic transition. Rather than looking at this event as a point in the natural trajectory of human progress we can look at it as one

point of order within the chaos of human experimentation. The difficulty as we search for order and explanations is to keep our eyes open to the evidence for the wealth and variety of human experience.

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Notes

1 Translations from Cresswell by the author.

6. A Quest for Antecedents: A Comparison of the Terminal Middle Palaeolithic and Early Upper Palaeolithic of the Levant

Gilbert B. Tostevin

Introduction

The significance of the Upper Palaeolithic is one of the most intriguing questions for Palaeolithic researchers. Due to the Levant's strategic location at a bottleneck between continents (*sensu* Sherratt 1996), a search for the geographic origins of the Levantine Upper Palaeolithic can play a more central role in determining the meaning and significance of the Upper Palaeolithic as a whole than in other regions (Fig. 6.1). Yet the importance of this research topic does not make it easier to address current methodological problems. Specifically, research on the origins of the Levantine Upper Palaeolithic has been hampered by methodological conflicts over how to characterize technological variability within and between assemblages. As the current approaches to characterizing intra-assemblage variability are unsuitable for determining degrees of difference and similarity between assemblages, not to mention identifying antecedents for Upper Palaeolithic flint knapping behaviour, these issues must be resolved before the importance of the Levant's role can be appreciated. This paper advances an analytical structure whereby the characterization of intra-assemblage variability across the Middle to Upper Palaeolithic transition aids, rather than detracts from, evaluations of inter-assemblage variability. An example of the comparison of one of the last Middle Palaeolithic assemblages in the Levant, Kebara Cave Unit VI, and the earliest Transitional or Upper Palaeolithic assemblage, Boker Tachtit Level 1, is used to place these methodological considerations in perspective.

A Quest for Antecedents

In discussing the origins of material culture innovations, anthropologists and historians of science frequently use the presence of antecedents to identify the region of origin of an innovation. As Barnett states, '...any innovation is made up of pre-existing components… No innovation springs full-blown out of nothing; it must have antecedents...' (1953:181). This principle is corroborated by social anthropology (Kluckhohn 1936; Kroeber 1940), history of science (Needham 1954; Basalla 1988:49, 55), and archaeological theory (Ford 1952:330; Deetz and Dethlefsen 1965; Dethlefsen and Deetz 1965; Willey *et al.* 1956:7; Renfrew 1978; Andrefsky 1987:19). Given the recognition by many disciplines that innovations take advantage of multiple, pre-existing elements in the construction of novel material culture, prehistorians are not alone in using the antecedent principle to source innovations in time and space. The antecedent principle has recently been applied to both Harrold's (1989) and Hovers' (1998) treatment of the Middle to Upper Palaeolithic transition in western Europe and the Levant, respectively. Despite its use in this context, however, the analysis of potential antecedents to the Upper Palaeolithic has been hampered by two serious problems.

First, there has been little connection between the analysis of the archaeological pattern of potential antecedents through time and space and a suitable body of anthropological theory that would explain the significance of the pattern. Tostevin (2000a, b) proposes one body of theory designed to distinguish archaeological examples of intra-regional innovation from inter-regional diffusion in an effort to fill this methodological gap. With this body of theory, it is possible to assess the goodness of fit between the archaeological record and model expectations, which predict how the record should appear given an *in situ* origin or an external origin for the Upper Palaeolithic.

The second problem, however, is potentially more difficult to resolve. There is as yet no consensus among lithic analysts on what constitutes an 'antecedent' or 'pre-existing component' for the lithic material culture of the Upper Palaeolithic. Is an antecedent in an assemblage the presence of one blade, many blades, a few Upper Palaeolithic retouch types, many Upper Palaeolithic retouch types, one prismatic core, or many prismatic cores? If all of these units are to be analysed as potential antecedents, how is each to be weighted in its importance to the question of the *in situ* origin of the Upper Palaeolithic in a particular region? These are fundamental questions, since an evaluation of whether or not a particular geographical region witnessed an *in situ* evolution of the

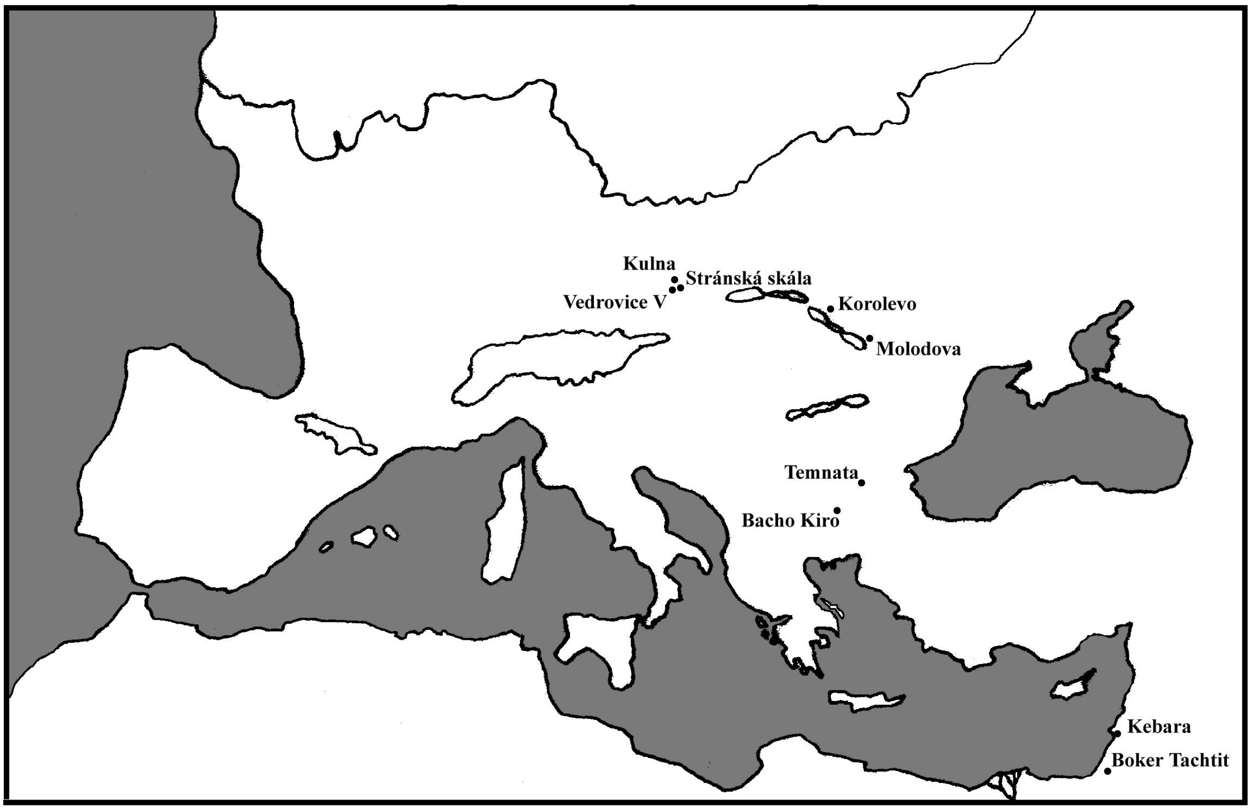

Fig. 6.1 Map showing location of assemblages used in the present study.

Upper Palaeolithic requires a quantitative assessment of the number of antecedents present. For, as noted by Tylor (1896), Steward (1929), and Andrefsky (1987), the more antecedents present in a region, the greater the probability that the evolution occurred *in situ* in that region. Thus, in looking for antecedents to Upper Palaeolithic behaviour, we must structure our units of analysis to facilitate the final, *quantitative* evaluation of those units to answer our question. Unfortunately, little concern has so far been devoted to this necessity.

Individual Precocious Artefacts as Antecedents

Consider the potential role of individual artefacts as antecedents. One prismatic blade core found in the context of a Late Middle Palaeolithic assemblage may be considered 'precocious' in nature if the assemblage is composed almost exclusively of flakes. The prismatic blade core may thus be thought of as an 'antecedent' to the dominant use of blades in the subsequent Upper Palaeolithic. The same argument holds for the appearance of one blade in a similar context. In Vishnyatsky's terminology, the blade or core would represent a 'running ahead of time' (1994:135). Despite the apparent logic of this type of argument, there are many reasons to avoid using anecdotal examples of single artefacts as antecedents.

First, individual precocious artefacts frequently appear in stratigraphic units of earlier periods for a plethora of reasons unrelated to the continuity of population-specific, learned traditions. Unfortunately, post-depositional alteration of artefact associations gives credence to the observation that the fewer the artefacts used to infer prehistoric behaviour, the more likely it is that the inference is based on intrusive pieces (see Courty *et al.* 1989; Goldberg *et al.* 1993; Karkansas *et al.* 2000). Thus, the very nature of deposits containing Palaeolithic artefacts makes it unwise to consider the presence of one or a few individual artefacts as evidence of behaviours representative of an entire assemblage.

Second, single or rare examples of an artefact type are more misleading than cumulative characterizations of variability. The principle of equifinality among many lithic operational sequences should render suspect the identification of a reduction strategy on the basis of a single precocious artefact. A single artefact, for instance, may represent '… the individual variability among flint knappers who were members of the same group; situations when expediency needs ruled over systematic core reduction; a short period (season?) of raw material shortage; training children as future artisans by using cores or thick flakes that adult knappers would consider to be unusable' (Bar-Yosef 1998b:44). An over-emphasis on intra-assemblage variability based on a few artefacts which are unrepresentative of the rest of the assemblage risks

treating idiosyncratic variation as antecedents, despite the lack of a relationship between the variation and the learned behaviours which constitute material culture traditions.

Third, even those individual artefacts that can be considered diagnostic of a particular operational sequence are problematic for use in an analysis of antecedents since such piece-by-piece representations often produce the same list of reduction strategies for many assemblages. For instance, in a survey of Levantine Mousterian intra-assemblage variability, Goren-Inbar and Belfer-Cohen (1998) point out that every assemblage contains some evidence of each of the Levallois reduction sequences known in the Levant. This intra-assemblage variability is present throughout the Levantine Mousterian despite the fact that each type of reduction sequence formed the dominant portion of the debitage during a different chronological period (Bar-Yosef 1998b; see Goren-Inbar and Belfer-Cohen 1998 for critiques of this scheme). The Tabun-type sequence demonstrates that if assemblage characterization is based on its constituent reduction strategies *without considering how representative they are of the whole*, one will always recognize the same list of reduction strategies despite major techno-chronological trends. If taken to an extreme, every lithic variable could be represented by an 'antecedent' in every period of prehistory.

While not entirely immune to the above problems, a quantified approach to characterizing intra-assemblage variability avoids, or at least lessens, problems with piece-by-piece characterizations of lithic assemblages. For instance, by using central tendency statistics to identify which knapping behaviours are representative of a lithic operational sequence, it is possible to recognize the anthropological significance of the presence of one blade core in a late Middle Palaeolithic context *versus* the presence of several or many blade cores. This is the scale at which analysts should search for antecedent lithic behaviours.

One final problem with the use of single, precocious artefacts as indicators of antecedents needs to be addressed. Even if post-depositional concerns and the equifinality of reduction strategies can be put aside, what does the fact that one prismatic blade core was made by a Late Middle Palaeolithic hominid tell the lithic analyst? Anthropologically, the fact means little, since the existence of that core does not signify that anyone but its knapper had the technical knowledge, *i.e.* the *connaissance* and *savoir-faire*, to produce that object. As Hovers (1998) points out in an excellent discussion of Renfrew's innovation theory (1978), an invention becomes an innovation only when the majority of the group adopts it. A single new artefact form represents only an invention that failed as an innovation. The technical knowledge represented by that one artefact, perhaps because it was not compatible with the social milieu of the majority of the group's population, died with the knapper. The implications of this point will be discussed later in this paper.

Antecedents in Anthropological Theory

Anthropological theory that distinguishes instances of independent innovation from inter-regional diffusion (Tostevin 2000a, b) relies upon the principle of 'technological style'; material culture traditions can be described based on the variation in how artefacts are made (Kroeber 1940; Lechtman 1977; Hughes 1987; Pinch and Bijker 1987; Lemonnier 1986, 1992). Ethnoarchaeology and archaeology demonstrate co-variance of technological variability with population groups that share other learned traditions (Lechtman 1977; Hodder 1979; Longacre 1981; Braithwaite 1982; Wiessner 1990; Childs 1991; Aronson *et al.* 1994; Stark 1995). This makes the principle of technological style appropriate for identifying changes in the learned traditions of different populations through time. Thus, by quantitatively measuring the degree of similarity or dissimilarity between the technological styles of assemblages through time in one region, it is possible to characterize the continuity or discontinuity of the learned traditions in that region. This is the process by which antecedents are recognized between assemblages and counted to characterize inter-assemblage continuity. Parsimony, the concept that the simplest explanation is the most probable, can then be used to distinguish a diffusion event from an independent innovation event by testing the goodness of fit between the actual degree of continuity/discontinuity within a region through time and the expected continuity/discontinuity for each type of event.

When applying the technological style concept to the material culture of the Upper Palaeolithic, the lithic operational sequence becomes the characterization of the technological style for each assemblage. An inter-assemblage comparison of operational sequence variability then becomes the measure of similarity/dissimilarity between assemblages through time. The description of this inter-assemblage variability must therefore include comparable units between assemblages. The comparability of these units is difficult to achieve, however, given the research trajectories which separated characterization of 'Middle Palaeolithic' technological variability from that of 'Upper Palaeolithic' assemblages (see White 1982:169; Harrold 1978, 1989).

For example, during most of the twentieth century, the Upper Palaeolithic was defined against the Middle Palaeolithic based on a blade/flake dichotomy, allowing little evaluation of degrees of similarity between assemblages; an assemblage was either flake-based or blade-based. Unfortunately, the use of the *index laminaire* as a relative scale between flake and blade dominance has not resolved the problem, since the lack of an exclusive correlation between blades and the Upper Palaeolithic makes the dichotomy artificial (Conard 1990; Révillion and Tuffreau 1994; Vishnyatsky 1994; Meignen 1994). Thus blades *per se* cannot be considered as antecedents to the Upper Palaeolithic.

Fortunately, since not all blanks with lengths twice their widths are the same, the concept of 'blade tech-

nology' as an antecedent can be divided into appropriate units of analysis. A specific blade technology production sequence or *chaîne opératoire* may differ in many details from another that also produces blades (Tixier 1984; Pelegrin 1990a; Meignen 1998). Yet how are the two blade operational sequences to be characterized? Frequently, lithic technologists following the French school define each *chaîne opératoire* type by its 'desired end products' and 'diagnostic' debitage (Boëda *et al*. 1990). If an assemblage contains specific elements of a particular *chaîne opératoire*, that assemblage must fall within that type. If it lacks these elements, it falls within another, frequently its own unique *chaîne*. Yet no quantitative assessment is possible between types such as *Levallois récurrent unipolaire* and *Levallois préférentiel centripète*. Because analytical units defining each *chaîne* are unique, this characterization method produces a typology of technological types similarly unsuitable for evaluating degrees of similarity/dissimilarity as the blade/flake dichotomy.

A point must be made concerning the use of typologies. The above criticism of the *chaîne opératoire* approach does not constitute a total condemnation of this typological system. It must be recognized explicitly to be a typological system, however, just as is Bordes' (1961a) tool typology. Both systems partition lithic variability into units or types for a particular function. As Adams and Adams (1991) note, every typological framework has particular functions and does not represent the end-all of possible analyses. A typology is just *one* way of dividing up variability for the purposes of a particular question. This point is frequently forgotten. Multiple typologies of lithic variability may, and perhaps should, be used concurrently to address multiple research topics (Andrefsky 2000). In searching for antecedents to the Upper Palaeolithic in the Middle Palaeolithic, the relevant anthropological theory requires an analytical system to structure description of intra-assemblage variability so as to facilitate comparison of inter-assemblage variability. The *chaîne opératoire* typological system is well suited to other research questions but, unfortunately, is not suitable for the task at hand.

What is needed to make the *chaîne opératoire* system more suitable to our needs is to define analytical units of categorical variables within each operational sequence that are comparable across assemblages. Assemblages must be recognized to consist of individual behavioural components that vary between (and within) assemblages through time and space. Yet definition and recognition of multiple components within an assemblage can be difficult. For instance, to what degree can a lithic analyst credit different reduction strategies as responsible for the debitage within a given assemblage? It is always possible to demonstrate that an assemblage contains debitage or cores of particular percentages with different dorsal scar patterns, say 60% unidirectional, 10% bi-directional, and 30% centripetal. But when can an analyst demonstrate that this pattern is a consequence of a dominant unidirectional strategy used on some cores and a subordinate centripetal strategy used on others? Unless different raw material types co-vary with technological attributes associated with different reduction strategies, a serious problem arises. How does one distinguish within an assemblage between two operational sequences which produce their own unique products (#1 producing products A, B, and C, while #2 produces D, E, and F) and one operational sequence which produces all of the products (#3 producing A, B, C, D, E, and F)? Refitting could resolve this problem, but the applicability of refitting is notoriously unevenly distributed in the archaeological record, making it a valued but inconsistent tool for comparisons of assemblages through time.

The striking disagreement between Boëda's (1988a) *lecture* of the knapping technology of the French Middle Palaeolithic assemblage of Biache Saint-Vaast, Level IIA, and Dibble's (1995a) technological attribute analysis of the same assemblage demonstrates the problem of the reliability of inferring multiple operational sequences within the same assemblage. Basing his conclusions upon an examination of the cores and debitage, Boëda inferred that three reduction systems were present: a unidirectional *recurrent* Levallois strategy (Schema A), a bi-directional *recurrent* Levallois strategy (Schema B), and a non-Levallois element. Boëda concluded that the two Levallois schemas were independently executed, *i.e*. each core was reduced unidirectionally or bi-directionally but never both. Dibble analysed the same debitage and demonstrated strong correlations between debitage length and the dorsal scar directions on the debitage. Longer debitage blanks are represented by a higher percentage of unidirectional dorsal scar patterns while shorter blanks are represented by a higher percentage of bi-directional, sub-radial, and radial scar patterns. A similar correlation was found between the amount of cortex on debitage blanks and dorsal scar pattern. As debitage blank length and percentage of cortex decrease as core reduction progresses, Dibble's attribute analysis demonstrated significant evidence for a relationship between Boëda's two schemas and the stage of reduction of the cores. In contrast to Boëda's claims for the schemas' independence, the most parsimonious explanation of Dibble's analysis is that cores were reduced at the beginning of their use-lives by a unidirectional strategy (Schema A) but later on this was replaced by a bi-directional strategy (Schema B).

Antecedents as Cumulative Behaviours Within the Operational Sequence

The Boëda-Dibble example is nevertheless instructive. While the *chaîne opératoire* approach alone has methodological problems, a combination of the strength of attribute analysis with the practice of dividing the operational sequence into a series of behavioural steps has great promise. Frequently, attribute analysis character-

izes the sum of an assemblage's technology rather than identifying the step-by-step knapping behaviours (Movius *et al*. 1968; Newcomer 1971; Collins 1975; Kozlowski and Ginter 1982; Sullivan and Rosen 1987; Johnson and Morrow 1987; Ahler 1989; Henry 1989b; Henry and Odell 1989). The American and French systems can productively be combined, since the theoretical basis behind the French technological school (Mauss 1936; Leroi-Gourhan 1943, 1945, 1964; Haudricourt 1987; Lemonnier 1986, 1989, 1992, 1993) agrees with the American 'technological style' approach to material culture variability. Both theoretical perspectives agree that different material culture traditions exploit different options within the manufacturing process for any given object. These options comprise the manufacturing behaviours observed, learned, taught, and disseminated among the group members. It is recognition of the anthropological significance of this step-by-step variability, combined with the use of attribute analysis to identify the variant used within each step, which provides the best analytical structure to search for antecedents to the Upper Palaeolithic.

The *chaîne opératoire* school frequently divides knapping into the following behavioural categories: raw material procurement, creation of striking platform(s), optional decortication, initial blank production, re-preparation of platform and debitage surfaces, late blank production, blank selection for tools, application of retouch, resharpening of tools, and discard of exhausted pieces. These categories can further be refined through experimental archaeology. Controlled experiments on flake fracture mechanics have demonstrated that a knapper controls a number of independent operational steps during the process of making stone tools (Speth 1972, 1974, 1975, 1981; Bonnichsen 1977; Dibble and Whittaker 1981; Cotterell *et al*. 1985; Dibble and Pelcin 1995; Pelcin 1996). Specifically, knapping steps related to platform treatment, dorsal ridge morphology, and subsequent placement of retouch are all functionally independent and together determine the morphology of each flake and tool (Pelcin 1996). The independence on a flake-by-flake basis of knapping behaviours enables division of the operational sequence into roughly independent behavioural domains:

1. core modification
2. platform maintenance
3. direction of core exploitation
4. dorsal surface convexity system
5. tool manufacture

Within each domain, several behavioural steps are present, each with its own set of equivalent options (*sensu* Sackett 1990:33). By compiling the analytical comparisons, tests, and attribute analyses according to the knapping behaviours for each step within the five independent knapping domains, a system is created to enable rigorous identification of specific knapping behaviours within each domain used to create a particular assemblage (Baumler 1988; Bergman 1987; Bordes 1961a; Crew 1975; Dibble 1995a; Dibble and Whittaker 1981; Géneste 1985; Henry 1989b; Hours 1974; Kuhn 1990, 1995; Meignen 1994, pers. comm.; Movius *et al*. 1968; Ohnuma 1986; Pelcin 1996; Speth 1981; Van Peer 1992, 1998; Volkman 1989). Most analyses are univariate tests and comparisons of pairs of flake and core attributes, using the principles of dimensional change during reduction (Holmes 1919; Frison 1968; Newcomer 1971; Collins 1975; Jelinek 1976; Stahle and Dunn 1982; Henry 1989b; Dibble 1987) and cortical change during reduction (Sullivan and Rosen 1985; Géneste 1985; Mauldin and Amick 1989; Baumler 1988; Ahler 1989; Dibble 1995a).

Table 6.1 summarizes the behavioural steps within the five knapping domains (and see Tostevin 2000b). The knapping steps within each domain are outlined as well as the specific analytical description to identify which option was used for each step. As noted earlier, the variability within each step requires quantitative characterization since almost every knapping option is used, if only to a small extent, in any given assemblage. Thus, these descriptions characterize the cumulative behaviours used by the knappers for each step of the process. The continuous variables frequently measure the central tendency of the variability within the particular knapping step. For discontinuous or categorical variables, the use of each option is quantified in order to gauge how representative it is of the behaviours used within that step as a whole. Consequently, the analytical units in this methodology are quantifiable, replicable, and representative of the behaviours used to create an assemblage. As such, this methodology is structured to characterize intra-assemblage variability so as to evaluate regional inter-assemblage variability.

Comparison of the Terminal Middle Palaeolithic and Early Upper Palaeolithic of the Levant

The Temporal Framework

To begin a quest for antecedents to the Upper Palaeolithic within the Middle Palaeolithic of the Levant, it is necessary first to address the temporal framework in which to look for antecedents. The antecedent principle states that the probability that a new material culture was developed *in situ* in a region is directly proportional to the number of antecedents already present in that region and inversely proportional to the number of innovations that are needed to make the new material culture out of the old. Great importance is thus placed on the number of acts of innovation in evaluating the probability of an *in situ* development. As with Renfrew's (1978) distinction between invention of an artefact and its adoption as an innovation, one must examine the continuity of the use of each innovation in order to evaluate the number of innovations within a block of time.

Table 6.1 Analytical Description of the Knapping Process.

Behavioural Domain	Knapping Step	Analytical Description
Core Modification	**Core Orientation:** Orientation of the raw material as a core: longitudinal *vs*. broad.	Core refits & extant core morphologies.
	Core Management: Strategic removals to rejuvenate surface convexities.	Core refits, extant core morphologies, *débordant* & crested debitage.
Platform Maintenance	**Platform Treatment:** Reparation of platform surfaces: core tablet, faceting, *etc*.	Platform type for tools and debitage.
	External Platform Angle: Tendency to use particular angles between debitage & platform surfaces.	Continuous variable.
	Platform Thickness: Tendency to place the point of percussion at a particular depth relative to platform edge.	Continuous variable.
Direction of Core Exploitation	**Direction of Cortex Removal:** Directionality of removal of cortical debitage, in both early and late reduction.	Correlation of percentage cortex with dorsal scar patterns on debitage & tools.
	Direction of Blank Removal: Directionality of removal of non-cortical debitage, in both early and late reduction.	Correlations of blank length with dorsal scar patterns on debitage & tools.
Dorsal Surface Convexity System	**Longitudinal Convexity:** Tendency to use longitudinal ridge systems (for blade products) *vs.* dispersed ridge systems (for flake products)	Length/Width ratio for tools and debitage.
	Shape of Convexity: Tendency to strike along parallel, convergent, expanding, or diffuse ridge systems.	Lateral edge type for tools and debitage.
	Curvature of Convexity: Tendency to utilize flat, curved, or twisted longitudinal core surfaces.	Profile type for tools and debitage.
	Lateral Convexity: Tendency to utilize one *vs.* two or more ridges as *nervures guides*.	Cross-section type of tools and debitage
	Vertical Convexity: Tendency to utilize greater or lesser vertical convexities per removal, quantifying the volumetric conception (*sensu* Boëda 1994) within an assemblage.	Width/Thickness ratio for tools and debitage.
Tool Manufacture	**Selection of Blank attributes for Tools:** Fourteen different blank attributes may be used as criteria for selecting pieces to be retouched as tools.	Statistical test (G^2 likelihood ratio) of deviation between tool and debitage sample for 14 given attributes.
	Unique Retouch Types: Tendency to use idiosyncratic types of retouch: carinate, bifacial, *etc*.	Presence/absence of specific retouch types.
	Tool Types: Tendency to place retouch on distal margins (UP) or lateral margins (MP) of blanks.	Tool kit dominated by MP or UP tool types, using a combination of Bordes' (1961a) and Hours' (1974) typologies.

An archaeological example will help illustrate the importance of continuity for antecedents. In recognizing the volumetric conception of blade technology in the early Middle Palaeolithic industry of Hayonim Cave, Meignen (1998:178) argues that, 'In sum, from the Middle Palaeolithic, when the laminar debitage was already known, through the Upper Palaeolithic, during which time this lithic production is overwhelmingly practiced, we can observe a change in the general trend rather than a real technical innovation.' Meignen is implicitly citing the early Middle Palaeolithic blade examples as antecedents for blade industries in the Upper Palaeolithic to argue that blade technology was not *innovated* at the beginning of the Upper Palaeolithic but at the beginning of the Middle Palaeolithic. However, because neither the hominids of the middle nor late Middle Palaeolithic in the Levant continued the practice of making these same blade technologies, it is impossible to claim that the hominids of the early Upper Palaeolithic in the Levant would have had knowledge of the specifics of that earlier innovation, 200,000 years before. Oral tradition alone cannot have stored and preserved this technical knowledge. While powerful in the preservation of poetry such as the *Iliad* over several thousand years, oral traditions require constant application and performance of the stored knowledge to preserve the information for any length of time. In addition to the absence of blade technologies in the middle period of the Middle Palaeolithic, the application and performance of the early Middle Palaeolithic blade technologies is not continued in even those few late

Middle Palaeolithic assemblages which have a relatively high laminar index, for instance Tor Faraj (Henry *et al.* 1996) and Amud B1 (Hovers 1998), as these blade technologies are not the same in their production details as those of Hayonim lower level E. Thus, unless the continuous practice of a specific blade production can be traced chronologically between the blade industries of the early Middle Palaeolithic and those of the early Upper Palaeolithic in the Levant, examples such as lower level E of Hayonim Cave (Meignen 1998) or Rosh Ein Mor (Marks 1992) will have little significance as behavioural antecedents to the Upper Palaeolithic.

The importance of the continuity of learned behaviours to the antecedent principle thus requires that antecedents to a specific assemblage must be sought in its *immediate* predecessor on the landscape. Just as it is inappropriate to look for antecedents for the early Upper Palaeolithic in the early Middle Palaeolithic without considering what happened in between, it is similarly inappropriate to look for antecedents for a 47,000 bp assemblage in a 70,000 bp assemblage, when a 48,000 bp assemblage exists for comparison. Whatever behaviours are evident in the 70,000 bp assemblages but which are not present in the 48,000 bp assemblages are thus *not available* as behavioural antecedents in the learned tradition of the hominids who created the 47,000 bp assemblages.

The consequences of this hard rule for chronological comparisons of learned behaviour are many. First, as new sites are excavated or re-dated, the most appropriate choice of assemblages for a pair-wise comparison between the terminal Middle Palaeolithic and the early Upper Palaeolithic in any given region will likely change. Second, the rule has the effect of reducing regional variability in a period of time to the signature of the last assemblage within that period. For the Levant, this has the effect of reducing the regional technological variability known to exist among Tabun B-type Middle Palaeolithic assemblages (Kebara Cave Units X–V, Amud B1, *etc.*) to the technological variability known to exist only within the most recent example of these industries.

This second consequence of the chronological concept has disadvantages and advantages. Of the disadvantages, the most significant is the lumping of assemblages found in different environmental landscapes into one regional pool, from which only one assemblage (and thus only one environment) may be chosen to represent either the last terminal Middle Palaeolithic or the first early Upper Palaeolithic assemblage. This effect tends to confound material culture differences which might be due to differences between the Levantine environments of the Mediterranean zone, the Irano-Turanian steppe, the Saharo-Arabian Desert, *etc.* (Henry 1995a:130–132). As more assemblages are studied with the approach advocated here, it will be possible to eliminate this problem by running pair-wise comparisons for each sub-region and comparing the results. Such a research project would be worthwhile; in the meantime, however, the best choice for a single pair-wise comparison remains the closest dated assemblages on either side of the Middle to Upper Palaeolithic transition within a broad geographic locality.

Of the advantages, the most important is the fact that the chronological rule avoids the reification of the analytical categories of ‘Middle Palaeolithic’, ‘transitional’, and ‘Upper Palaeolithic,’ by preventing the comparison of ensembles of assemblages combined to represent an analytical unit, such as the Middle or Upper Palaeolithic as a whole. Such characterizations of the transition do not elucidate how or why the transition occurred, just that one did. With the chronological comparison of temporally adjacent assemblages, however, one can study the changes in flint knapping behaviours at each temporal junction between dated assemblages. Multiple transitions may become apparent at this resolution.

Sampling Considerations

For the comparison of the terminal Middle Palaeolithic and early Upper Palaeolithic of the Levant, there are three requirements for selecting appropriate assemblages for study, in addition to the requirement that these assemblages *immediately* succeed each other in time:

1. Because technological studies of debitage are particularly vulnerable to problems with artefact associations, assemblages must have been excavated with rigorous collection and proveniencing methods in order to assure the association of artefacts with a common depositional period in the site. This requirement eliminates many potential assemblages.
2. The assemblages must be associated with adequate radiometric dates as well as geological data to assign them to a specific date between 60–30,000 bp, the period during which the Middle to Upper Palaeolithic transition occurred across Eurasia. While a narrower time period can be used, the larger time block places any transition in the context of the technological variability before and after the event.
3. The assemblages should represent each of the known industrial types within the region during the period in question.

Based on these three factors and the chronological rule above, the assemblage from Kebara Cave, Unit VI was chosen to represent the terminal Middle Palaeolithic in this pair-wise comparison. Although the stratigraphic unit that directly underlies the Upper Palaeolithic deposits at Kebara is Unit V, Unit VI was chosen because of stratigraphic uncertainties differentiating between Unit IV (Upper Palaeolithic), and the Middle Palaeolithic Unit V (Bar-Yosef *et al*. 1996:301). Unit VI yielded an AMS date of >48,000 bp (Gif-TAN-90029) and a TL date of 48,300 ± 3,500 bp (Valladas *et al*. 1987). The assemblage from Amud B1/6, possessing an ESR date range of 43,000 ± 5000 bp (early uptake) to 48,000 ± 6000 (late uptake)

(Schwarcz and Rink 1998), is also a likely candidate (Hovers *et al.* 1995; Hovers 1998). The possible inclusion of this assemblage alongside Kebara VI warrants further study.

To represent the Early Upper Palaeolithic, the assemblage from Boker Tachtit level 1 was chosen. Argued to demonstrate *in situ* development of Upper Palaeolithic blade technology from a Middle Palaeolithic technology (Marks 1990), the absence of a Middle Palaeolithic retouched tool kit has led to suggestions that basal Boker Tachtit represents a fully Upper Palaeolithic occupation (Bar-Yosef 1994; Bar-Yosef *et al.* 1996). This occupation produced several radiocarbon dates, of which 47,280 ± 9,050 bp (SMU-580) is the oldest.

The sampling protocols for the assemblages are described below.

Kebara Cave, Unit VI

Kebara Cave is situated at the western edge of Mt. Carmel, overlooking the Mediterranean coastal plain. First excavated by Turville-Petre (1932) and later by Stekelis (Schick and Stekelis 1977), the deposits contain a sequence from the Middle Palaeolithic to the Epipalaeolithic. The sample studied derives from the recent excavations headed by Bar-Yosef and Vandermeersch (1982–1990) (Valladas *et al.* 1987; Bar-Yosef *et al.* 1992; Meignen and Bar-Yosef 1988, 1991; Bar-Yosef *et al.* 1996). This unit is relatively rich in debitage and tools and a sample from 5m² was sufficient for the purposes of the technological study. This choice was influenced by proximity to the western profile of the excavation.

Boker Tachtit, Level 1

Boker Tachtit is an open-air site in the central Negev Desert of Israel. Excavated during the Southern Methodist University project in the Avdat/Aqev area in the late 1970s (Marks 1983b; Marks and Volkman 1983), four superimposed cultural horizons were identified, three of which were extremely rich in artefacts. Extensive refitting was conducted on the material, allowing the vast majority of the lithic operational sequences to be defined with great accuracy (Volkman 1983, 1989).

The published analyses of the refits serve as the substantive support for the following discussion of the Boker Tachtit level 1 operational sequence, since most individual artefacts themselves are currently almost impossible to study due to the refitting. Amongst the unrefitted items a sample of 100 artefacts from five squares was studied with the attribute analysis advocated here in order to produce comparable data for the study.

Comparison of Kebara Unit VI and Boker Tachtit level 1

Table 6.2 compares the operational sequences of the assemblages from Kebara Unit VI and Boker Tachtit level 1. This presents each knapping step in the sequence by behavioural domain and characterizes the cumulative behaviours used for each step of the sequence in the production of the two assemblages. Judgement of the significance of any difference between the assemblages' choice of option for each step in the operational sequence is also indicated. Thus, steps related to data taken from cores or refits are often qualitative, while steps related to data from flakes and tools are mostly quantitative. Unidentifiable variable states, such as crushed platforms, unreadable exterior platform angles, *etc*., were not included in the calculation of descriptive statistics used in this table. A 'p' value indicates the probability that the data obtained from the two assemblages were randomly derived samples from the same population (*i.e*., with the assumption that they were produced by the same cumulative behaviours). A significance level of 5% is used here for all statistical tests, including student's t-test or G^2 likelihood ratio (approximating the *chi*-square distribution) (Sokal and Rohlf 1995).

If one instance of agreement exists between the two assemblages for a given knapping option used in a given behavioural step, then it is possible to argue that the earlier assemblage possesses an antecedent for the behaviour in that step in the later assemblage. It is thus possible to search for and count antecedents for Boker Tachtit 1 within Kebara VI on a step-by-step behavioural basis. Evaluation of the goodness of fit between the archaeological record and the continuity/discontinuity of behaviours expected given a diffusion event *versus* an independent innovation event can proceed based on this step-by-step counting of antecedents (see Tostevin 2000a for a discussion of the models and test expectations).

Any antecedents can also be treated quantitatively to evaluate the competing hypotheses. However, to produce a quantitative measure of the difference (or similarity) between assemblages, one cannot simply sum up the number of operational steps in which a significant difference exists between the two options, as this would bias the results through the interdependence of the units. Specifically, while flake fracture mechanics experiments show that knapping options are functionally independent *between* the five knapping domains, the possibility remains that options *within* each domain may affect subsequent options during core reduction, as experiments have not tried to control for this issue. It is thus necessary to avoid counting the same units twice, a situation known in statistics as Galton's Problem (Tylor 1889 in Moore 1961; Thomas 1986:448). In order to quantify pair-wise assemblage comparisons, therefore, the knapping steps in which significantly different options were used between assemblages are first summed *within* their specific knapping domain and divided by the total number of steps within that domain. The resulting numerical values of all five domains are then summed up to produce a measure ranging from 0 (for assemblages with identical operational

Table 6.2 Comparison of the Operational Sequences of Kebara Unit VI and Boker Tachtit Level 1.

FLINT KNAPPING STEPS BY DOMAIN	**Kebara VI**	**Boker Tachtit 1**	**Significant Difference?**
CORE MODIFICATION			
Core Orientation	Broad, flat orientation	Longitudinal	Yes
Core Management	*Débordant*	*Débordant* & frontal crest	Yes
Number of Differences/2 Steps			2/2=1
PLATFORM MAINTENANCE			
Platform Treatment	Unprepared: 50% Prepared: 50% n=504	Unprepared: 61% Prepared: 39% n=79	No p=.07
External Platform Angle (degrees)	mean: 87.4, s.d.: 16.1, n=474	mean: 88.4, s.d.: 13.6, n=63	No, p=.63
Platform Thickness	mean: 4.78, s.d.: 2.48, n=475	mean: 4.04, s.d.: 2.16, n=65	Yes, p=.02
Number of Differences/3 Steps			1/3=0.33
DIRECTION OF CORE EXPLOITATION			
Direction of Cortex Removal	Unidirectional changing to Sub-centripetal	Unidirectional	Yes
Direction of Blank Removal	Unidirectional & Bi-directional	Bi-directional changing to Unidirectional	Yes
Number of Differences/2 Steps			2/2=1
DORSAL SURFACE CONVEXITY SYSTEM			
Longitudinal Convexity: Length/Width Ratio	mean: 1.78, n=603 s.d.: 0.82,	mean: 2.25, n=101 s.d.: 1.21,	Yes p=.00
Shape of Convexity: Lateral Edges of Blanks	Parallel: 37% Convergent: 29% Expanding: 23% Ovoid: 11% n=584	Parallel: 71% Convergent: 12% Expanding: 5% Ovoid: 12% n=101	Yes p=.00
Curvature of Convexity: Profile of Blanks	Straight: 68% Curved: 18% Twisted: 14% n=597	Straight: 40% Curved: 40% Twisted: 21% n=101	Yes p=.00
Lateral Convexity: Cross-Section of Blanks	Triangular: 47% Trapezoidal: 36% Other: 17% n=574	Triangular: 55% Trapezoidal: 40% Other: 5% n=101	Yes p=.00
Vertical Convexity: Width/Thickness Ratio	mean: 5.18, s.d.: 2.62, n=603	mean: 4.43, s.d.: 2.33, n=101	Yes, p=.01
Number of Differences/5 Steps			5/5=1
TOOL MANUFACTURE			
Unique Types of Retouch	Normal retouch	Bifacial thinning retouch	Yes
Tool Types	MP tools dominate	UP tools dominate	Yes
Number of Differences/2 Steps			2/2=1
Total Measure of Difference Weighted by Behavioural Domains			**4.33**

sequences) to 5 (for entirely different operational sequences, *i.e.* without any antecedents). This procedure thus scales the measure of difference according to the variability seen between these five domains.

It must be noted that, although some interdependence has been avoided with the above methodology, this study introduces its own bias in the structuring of pair-wise assemblages' comparisons. Specifically, as the number of steps within each of the five domains differs, the steps in different domains are not weighted evenly. This situation is intentional, in that the number of steps within a domain reflects the potential for functional constraints to affect the choice of knapping options within that domain. Thus tool manufacture is the most influenced by functional utility and has the largest number (16) of steps within the domain. Direction of core exploitation, on the other hand, has little or no effect on the functional utility of the resulting products and so, suitably, it has only two behavioural steps. This bias in the structure of the pair-wise comparisons should be kept in mind when evaluating the similarity/dissimilarity between assemblages traditionally grouped together based on tool typology alone.

Although both the degree of independence between the five domains and the intentional selection of particular domains as sensitive or insensitive to functional utility will likely generate debate among lithic analysts, it is important to stress that a rigorous and replicable analytical structure is essential for the comparison of lithic assemblages through time and space. Until more experimental studies are conducted in the tradition of Dibble and Pelcin (1995) and Pelcin (1996), contention over relative degrees of independence between knapping behaviours within the analytical structure advocated here is less important than the actual creation and implementation of an analytical structure. Just as the structure of Bordes' typology (1961a) has aided Palaeolithic research while undergoing debate (Bordes 1961b; Binford and Binford 1966; Mellars 1969) and refinement (Debénath and Dibble 1994; Dibble 1995b), it is hoped that the present effort to structure technological comparisons of assemblages will facilitate further research.

The following discussion of the pair-wise comparison between Kebara Cave Unit VI and Boker Tachtit level 1 is based on the procedures advocated above. It does not present the description of the lithic data or the argumentation that led to these interpretations (see Tostevin 2000b).

Core Modification

The first step in the core modification domain, core orientation, represents the initial orientation and shaping of the raw material. This distinguishes between different core forms, based on extant core morphology and evaluation of platform locations during most of core exploitation. In Kebara VI, it is clear from the location of bulbar negatives on the different core surfaces that broad-faced surfaces were chosen exclusively over narrow-aspect surfaces. In the case of Boker Tachtit 1, both Volkman's refittings and personal examination of the location of bulbar negatives on the different core surfaces indicate that most cores were oriented longitudinally to exploit the narrow core surface. Qualitatively different options were used for this step between the two assemblages. Kebara VI thus does not possess the antecedent for this step in the operational sequence.

For the second step in this domain, core management was also different between the assemblages. While the cores and debitage from both Kebara VI and Boker Tachtit 1 use the *débordant* option, the frontal crests to create and maintain dorsal surface convexities in Boker Tachtit 1 represent a significant deviation from Kebara VI.

Platform Maintenance

This domain includes three steps whereby the knapper modifies the platform surface and edge before each removal. In the case of the Kebara VI *versus* Boker Tachtit 1 comparison, only the tendency in the latter assemblage to strike closer to the platform edge, measured by debitage platform thickness, differed significantly. The use in both assemblages of platform faceting and equivalent exterior platform angles indicates that Kebara VI possesses antecedents for two of the three possible steps within this domain.

Direction of Core Exploitation

The first step in this domain, the direction of cortex removal, shows dissimilar choices by the knappers of these two assemblages. A cross-tabulation of cortex percentage and dorsal scar directions on debitage indicates that Kebara VI was reduced unidirectionally during initial cortex removal but gradually included more sub-centripetal reduction. A similar cross-tabulation of debitage data from Boker Tachtit 1 illustrates a different option: unidirectional removal of cortical pieces with no shift in strategy. The determination of the second step in this domain, the direction of non-cortical blank removal, relies upon a cross-tabulation of blank length with dorsal scar directions. For this step, Kebara VI shows no shift in strategy but continued unidirectional and bi-directional approaches. Cross-tabulation on Boker Tachtit 1, however, illustrates a clear shift from bi-directional reduction at the beginning of core exploitation to unidirectional reduction at the end of the lives of the cores. This interpretation, based on attribute analysis, is corroborated by Volkman's refits (for instance, see Volkman 1989: Figs. 6.7, 6.8, 6.9, 6.13). Neither step within this domain demonstrates the existence of an antecedent behaviour for Boker Tachtit 1 within Kebara VI. It is interesting to note that Kebara VI, while recognized to be a Tabun B-type industry, does not possess a large amount of debitage with unidirectional-convergent scar patterns (only 17.8% compared to 27.1% unidirectional, 19.3% bi-directional, 10.3% crossed, 11.2% sub-centripetal, 4.7% centripetal, 2.5% crested, and 7.2% indeterminate, see Tostevin 2000b: Table 7.6).

Dorsal Surface Convexity System

The dorsal surface convexity domain includes the knapping steps that encapsulate the cumulative tendencies to use particular ridge patterns on the core exterior for the production of blanks. Of the possible five steps all options were statistically different between the two assemblages. The debitage and tools from Boker Tachtit 1 illustrate use of core convexities that are more longitudinal, more parallel sided, more curved in profile, dominated by single ridges, and less Levalloisian (width/thickness ratio of 4.43 compared to 5.18) in its use of vertical convexities than Kebara VI.

Tool Manufacture

For the tool manufacture domain, only retouch type and tool kit composition are comparable between these two assemblages due to the lack of blank selection criteria for Boker Tachtit 1, which was unavailable in published form and from the un-refitted debitage. While Kebara VI has predominantly Middle Palaeolithic tool types (114 tools out of 990 artefact sample) with no bifacial retouch, Boker

Tachtit 1 has the bifacial thinning retouch associated with Emireh points and a dominance of Upper Palaeolithic tool types (Marks 1983b: Table 5.9: Upper Palaeolithic types represent 75.3% of the retouched tools, excluding unretouched pieces and Levallois blank types). This final domain thus produced a measure of difference of 2/2.

Final Measure of Difference

The final measure of difference between the operational sequences of Kebara Unit VI and Boker Tachtit level 1, weighted by the five knapping domains, produces a value of 4.33 out of a possible maximum difference of 5.0. This value is the greatest witnessed in 22 pair-wise comparisons between 18 assemblages dated 60–30,000 bp over three regions (the mean value is 2.34; Tostevin 2000a, b). This value of 4.33 indicates that the operational sequences are in fact extremely dissimilar and that few antecedents for the behaviours that created Boker Tachtit 1 can be found in Kebara VI.

Despite the arguments for an *in situ* technological transition between the Middle and Upper Palaeolithic at Boker Tachtit, the basal assemblage already differs as much as possible from its immediate temporal predecessor on the Levantine landscape, Kebara VI. This indicates that any 'transition' was already underway at the time of Boker Tachtit level 1. While Marks (1990, 1992) has argued that the early Middle Palaeolithic Negev site of Rosh Ein Mor is the progenitor of a Tabun D-type lineage culminating in the Boker Tachtit level 1 assemblage, there is currently no chrono-stratigraphic evidence for such continuity (Bar-Yosef 1998b). Demidenko and Usik (1993a) suggested that the 'bladey' Levalloisian industries dated to 70,000 bp at Tor Faraj and Tor Sabiha in Jordan (Henry 1992, 1995a, b) may provide this continuity. Yet more fieldwork needs to be conducted in both Israel and Jordan to find a later (*i.e.* 50–47,000 bp) example of similar industries before one can replace Kebara VI as the immediate predecessor to Boker Tachtit level 1 in a comparison such as this.

Conclusions: The Levantine Case Study in a Wider Context

The above comparison of Kebara Cave Unit VI and Boker Tachtit level 1 illustrates how antecedents to the Upper Palaeolithic can be sought within the Middle Palaeolithic in any region. This approach within regional contexts can also be applied *between* regional contexts. A study of knapping behaviours between 60–30,000 bp in three regions of the Old World (the Levant, central Europe, and eastern Europe) was conducted (Tostevin 2000a, b) in order to evaluate the suggestive geographic trend in radiometric dates for the earliest Upper Palaeolithic industries in western Eurasia (Bischoff *et al.* 1989; Cabrera Valdes and Bischoff 1989; Straus 1989, 1994; Kozlowski 1990; Otte and Keeley 1990; Rink *et al.* 1996; Bar-Yosef *et al.* 1996; Mellars 1996a). The findings demonstrate that the pattern of change in knapping behaviours within the Levant is not exceptional but quite similar to what transpired in both central Europe and eastern Europe. The beginnings of the Levantine Upper Palaeolithic were part of a much larger phenomenon that did not actually originate in that region.

When examining the quantitative dissimilarity (*i.e.*, a count of antecedents) between assemblages through time in each region (Table 6.3; see Tostevin 2000a, b for more details), the Middle Palaeolithic assemblage in each region is succeeded by an assemblage with an extremely different technological style. Whether 'transitional' or 'Upper Palaeolithic,' these three post-Middle Palaeolithic assemblages are in fact quite similar to *each other*. The pair-wise comparisons between Boker Tachtit level 1 and the Bohunician assemblage of Stranska skala IIIa–4 in central Europe (producing a difference value of 1.93) and between Boker Tachtit level 1 and the first non-Middle Palaeolithic assemblage in eastern Europe, Korolevo II Complex II (producing a value of 1.93), are extremely surprising given their geographical separation. The first comparison is less than twice as different as the value between the Stranska skala Bohunician assemblages themselves (IIIa level 4 and III, producing a value of 0.98) or between the directly stratified Levantine Aurignacian assemblages at Kebara Cave (Units II and I, producing a value of 1.51). Comparison of Boker Tachtit level 2 to Stranska skala IIIa level 4 produces a value (1.40), which is actually closer than the value between the European Aurignacian (Stranska skala IIIa level 3 and IIa level 4) and the Levantine Aurignacian assemblages (Kebara Unit I) (1.81), although Boker Tachtit level 2 shows fewer similarities with Korolevo II Complex II (2.26). These comparisons point to a common behavioural phenomenon appearing after the last Middle Palaeolithic assemblage in each region.

In order to use the antecedent principle to determine whether or not the Upper Palaeolithic appeared as an *in situ* innovation within a region or by diffusion between regions, it is important to investigate the contingency of the knapping behaviours beyond a simple comparison of the measure of difference between assemblages. This is vital, since the summation of assemblage differences condenses all of the variability between assemblages into one value, so that two different assemblages may appear equally similar to a third but not possess similar options between them. This is not the case, however, with the behavioural options employed in the different steps of the operational sequences of Boker Tachtit level 1, Stranska skala IIIa level 4, and Korolevo II Complex II. When examining the specific knapping options used in these three assemblages, their antecedents cannot be found within the details of the Middle Palaeolithic operational sequences in each region (Table 6.4). Further, the same specific options that make these assemblages so different from the preceding Middle Palaeolithic assemblages are in fact common to all three assemblages. Despite the

Table 6.3 Measure of Difference in Knapping Behaviours between Assemblages for the Central Europe, Eastern Europe, and the Levant.

Regional Sequence of Change	Comparison of Assemblages Through Time (Industrial Affiliation, Radiometric Date)	Measure of Difference (Maximum=5, Minimum=0)
Levant	Kebara Cave Unit VI (Levantine Mousterian) *versus* Boker Tachtit level 1 (transitional)	4.33
Central Europe	Kṳlna Cave Layer 7a (Micoquian) *versus* Stranska skala IIIa–4 (Bohunician)	3.76
Eastern Europe	Molodova V Layer 11 (Middle Palaeolithic) *versus* Korolevo II–II (transitional)	3.44
Inter-Regional Comparisons	Boker Tachtit level 1 *versus* Stranska skala IIIa–4	1.93
	Boker Tachtit 1 *versus* Korolevo II–II	1.93
	Stranska skala IIIa–4 *versus* Korolevo II–II	2.56
	Boker Tachtit 2 *versus* Stranska skala IIIa–4	1.40
	Boker Tachtit 2 *versus* Korolevo II–II	2.26
	Kebara I (Levantine Aurignacian) *versus* Stranska skala IIIa–3 & Iia–4 (Aurignacian)	1.81

geographical distances separating them, the assemblages of Boker Tachtit level 1, Stranska skala IIIa level 4, and Korolevo II Complex II all possess a specific and unique cluster of knapping options (Table 6.5).

Parsimony favours the conclusion that all three assemblages share the same behavioural package which diffused from one region to another, appearing first in the Levant at 47/46,000 bp, next in central Europe by 42,000 bp, and finally in eastern Europe by 38,000 bp (Tostevin 2000a). The entire operational sequence is not exactly the same in each assemblage but this variance is to be expected in any diffused set of behaviours. For instance, although the differences between Stranska skala IIIa–4 and Korolevo II–II are greater than the differences between these assemblages and Boker Tachtit level 1 (2.56 *versus* 1.93), the behaviours within the diffused package would have continued to deviate through time and space, a process Deetz and Dethlefsen (1965) called the Doppler Effect, as the package proceeded down two paths, one toward central Europe, and one to eastern Europe.

Further research is needed within each region to increase the sample of assemblages representative of the period between 60–30,000 bp. Yet, the current data supports the conclusion that these three assemblages (Boker Tachtit level 1, Stranska skala IIIa level 4, and Korolevo II Complex II) represent the diffusion of a phenomenon we may call the 'Bohunician Behavioural Package,' named after the central European industry marking its northwestern-most distribution (it does not appear to have reached western Europe). This appellation is only fitting given the fact that central and eastern European scholars (Valoch 1990; Kozlowski 1990; Ginter *et al.* 1996; Demidenko and Usik 1993a) were the first to notice morphological similarities among these disparate assemblages. The regional origin of this behavioural package should be sought in adjacent localities, including southeastern Europe, the Nile Valley, and Anatolia.

The 'Bohunician Behavioural Package' is the first of two diffusion events evidenced by this research, the second being the 'Aurignacian Behavioural Package,' introducing a new distinctive suite of knapping options to the Levant (Kebara Cave Unit II) and central Europe (Stranska skala Iia–4 and IIIa–3) (Tostevin 2000a, b). As with its predecessor, the 'Aurignacian Behavioural Package' did not possess sufficient antecedents within any of the three regions studied to warrant an *in situ* appearance in these regions.

Discussion of the consequences of this research for

both the Levantine Middle to Upper Palaeolithic transition as well as the central and eastern European transitions is beyond the scope of this paper. Nevertheless, the example of the comparison of two technological styles at the Middle to Upper Palaeolithic transition in the Levant illustrates how the quest for antecedents can proceed and what fascinating results such an endeavour produces. As long as antecedents are sought by means of quantitative, cumulative characterizations of the contingent details within the technological styles of immediately successive lithic assemblages, the antecedent principle will light our way to a richer understanding of the origins of the Upper Palaeolithic, in the Levant and elsewhere.

Table 6.4 Operational Sequences for the first Pair-wise Comparisons in Each Region.

	The Levant
Kebara Cave Unit VI	
Core Modification:	Broad-face Orientation; *Débordant* Core Management
Platform Maintenance:	Prepared Platforms, ~87 degree External Platform Angle, ~5 mm Platform Thickness
Direction of Core Exploitation:	Unidirectional changing to Sub-centripetal Cortex Removal, Independent Unidirectional & Bi-directional Blank Removal
Dorsal Surface Convexity:	Varied Lateral Edges, Straight Profile, Length/Width Ratio of 1.78, Width/Thickness Ratio of 5.18
Tool Manufacture:	Levallois flakes & sidescraper tool kit
Boker Tachtit Level 1	
Core Modification:	Longitudinal Orientation; *Débordant* & Frontal Crest Core Management
Platform Maintenance:	Plain & Faceted Platforms, ~88 degree External Platform Angle, ~4 mm Platform Thickness
Direction of Core Exploitation:	Unidirectional Cortex Removal, Bi-directional changing to Unidirectional Blank Removal
Dorsal Surface Convexity:	Parallel & Convergent Lateral Edges, Length/Width Ratio of 2.25, Width/Thickness Ratio of 4.43
Tool Manufacture:	Emireh points, Levallois points, endscraper & burin tool kit
	Central Europe
Kùlna Cave Layer 7a	
Core Modification:	Unifacial Discoidal with secant surfaces; Convexity Management by Centripetal Removals
Platform Maintenance:	Plain & Prepared Platforms, ~84 degree External Platform Angle, ~9 mm Platform Thickness
Direction of Core Exploitation:	Unidirectional changing to Crossed Cortex Removal, Sub-centripetal changing to Unidirectional Blank Removal
Dorsal Surface Convexity:	Parallel & Expanding Lateral Edges, Trapezoidal Cross-section, Length/Width Ratio of 1.44, Width/ Thickness Ratio of 2.83
Tool Manufacture:	Bifaces & bifacial sidescraper tool kit
Stranska skala IIIa Layer 4	
Core Modification:	Longitudinal Orientation; *Débordant*, Frontal Crest, & Side Blade Core Management
Platform Maintenance:	Plain & Faceted Platforms, ~85 degree External Platform Angle, ~5 mm Platform Thickness
Direction of Core Exploitation:	Unidirectional Cortex Removal, Bi-directional changing to Unidirectional Blank Removal
Dorsal Surface Convexity:	Parallel & Convergent Lateral Edges, Length/Width Ratio of 1.71, Width/Thickness Ratio of 3.99
Tool Manufacture:	Levallois points & Upper Palaeolithic endscraper tool kit
	Eastern Europe
Molodova V Level 11	
Core Modification:	Broad-face Orientation; Core Management by *Débordant* & Centripetal Removals
Platform Maintenance:	Faceted Platforms, ~86 degree External Platform Angle, ~6 mm Platform Thickness
Direction of Core Exploitation:	Centripetal Cortex Removal, Sub-centripetal changing to Centripetal Blank Removal
Dorsal Surface Convexity:	Varied Lateral Edges, Length/Width Ratio of 1.78, Width/Thickness Ratio of 4.94
Tool Manufacture:	Mousterian points & sidescraper tool kit
Korolevo II Complex II	
Core Modification:	Longitudinal Orientation; *Débordant* & Frontal Crest Core Management
Platform Maintenance:	Plain Platforms, ~90 degree External Platform Angle, ~8 mm Platform Thickness
Direction of Core Exploitation:	Unidirectional Cortex Removal, Bi-directional changing to Unidirectional and Crossed Blank Removal
Dorsal Surface Convexity:	Length/Width Ratio of 1.71, Width/Thickness Ratio of 4.10
Tool Manufacture:	Flatly-retouched Foliate points & Upper Palaeolithic endscraper tool kit

Table 6.5 Knapping Behaviours Within the 'Bohunician Behavioural Package'.

Core Modification:	Longitudinal Orientation; *Débordant* & Crested Blade Core Management
Platform Maintenance:	Plain & Faceted Platforms, ~86 degree External Platform Angle, ~4 mm Platform Thickness
Direction of Core Exploitation:	Unidirectional Cortex Removal, Bi-directional changing to Unidirectional Blank Removal
Dorsal Surface Convexity:	Length/Width Ratio of 1.80, Width/Thickness Ratio of 4.25
Tool Manufacture:	Levallois point & endscraper toolkit
Assemblages:	Boker Tachtit 1 & 2, Stranska skala IIIa–4 & III, Korolevo II–II, possibly Kulychivka lowest complex (Demidenko and Usik 1993b), possibly Temnata Cave Layer VI, Sector TD–II (Ginter *et al.* 1996), and possibly Korolevo I–2B (Demidenko and Usik 1993a).

7. The Middle/Upper Palaeolithic Transition in Northern and Southern Israel: A Technological Comparison

Josette Sarel and Avraham Ronen

Introduction

Garrod and Neuville were the first to subdivide the Levantine Upper Palaeolithic, establishing a six-phase unilinear sequence that begins with a 'transitional' phase (Neuville 1934; Garrod 1951, 1954. Neuville called it 'Phase I' and Garrod called it 'Emiran'). Raqefet Cave, on the eastern side of Mount Carmel, northern Israel displays industries containing both Mousterian and Upper Palaeolithic implements that underlie Levantine Aurignacian layers (Noy unpublished report). These assemblages, which are marked by the association of Levallois implements and Upper Palaeolithic laminar products, are similar to those defined as 'transitional' or 'Emiran' by Garrod and Neuville, such as those from the caves of Emireh, el-Wad G, F and Kebara E.

The mixed nature of this 'transitional' phase has raised the problem of its credibility. It was suggested that erosion and major karstic activities at the end of the Mousterian had disturbed the archaeological beds in northern Israel and were responsible for these mixed assemblages (Bar-Yosef and Vandermeersch 1972). Nevertheless, a 'transitional' phase, well stratified at Ksar Akil (Copeland 1975) and Boker Tachtit (Marks 1983a, c), has been recognized.

Today, scholars are well aware of cave formation processes and more attention is paid to the geological contexts of the archaeological record. The studies of sediments and mineral assemblages in Hayonim and Kebara caves (Weiner *et al*. 1995; Goldberg and Bar-Yosef 1998) have revealed the complexity of the site formation and post-depositional processes within caves in northern Israel, that can significantly influence the archaeological layers. Anthropogenic, geogenic and biogenic processes can all displace artefacts to varying extents (Goldberg and Bar-Yosef 1998). This tends to support the postulate that the 'transitional' assemblages in northern Israel are the outcome of such processes (Bar-Yosef and Vandermeersch 1972). Nevertheless, 'transitional' assemblages were uncovered in sites where no significant disturbances were reported, such as Umm el-Tlel in Syria (Boëda and Muhesen 1993), Ksar Akil in Lebanon (Copeland 1975), and Boker Tachtit in southern Israel (Marks 1983a, c). This fact leads us to raise doubts as to the extent and impact of post-depositional processes in the caves of northern Israel. It is possible that erosional events and karstic activities occurred within the 'transitional' layers and not between the Mousterian and the Upper Palaeolithic horizons. Thus the assemblages exhibiting both Levallois products and Upper Palaeolithic-type blades are not necessarily the result of mechanical admixtures, but could testify for the existence of the 'transitional' phase, as it was previously perceived by Garrod and Neuville.

To validate the occurrence of 'transitional' assemblages in northern Israel, it is necessary both to determine the site formation processes in each cave, and to analyze the possible cultural relationships between them and the Lebanese, Syrian and southern Israeli 'transitional' industries.

In this paper we present our preliminary analysis of the Levallois and laminar cores and tools of the 'transitional' phases of Raqefet Cave, and compare the results with those from other northern Israeli assemblages, as well as from Ksar Akil in Lebanon, and Boker Tachtit in southern Israel.

Some scholars use the term 'Initial Upper Palaeolithic' as it appears to be a neutral term compared with the term 'transitional phase' previously used, which implies a phylogenetic relationship between the Mousterian and the Upper Palaeolithic (Kuhn *et al*. 1999). Others use the term 'Intermediate Period', which does not relate the assemblages to either the Middle or the Upper Palaeolithic (Boëda and Muhesen 1993). The term 'late Mousterian' *(Moustérien tardif)* has been employed recently because of the Levallois implements that characterize this industry (Bourguignon 1996:317–336). In the present paper, the original term 'transitional' is used for convenience, but it does not imply any cultural continuity.

Levallois and Laminar Knapping

Levallois flaking

The definition of the Levallois method is still considered controversial. According to Bordes, the Levallois method is aimed at the morphology of the desired products and the predetermined shape is attained by prior removals (Bordes 1980). For Boëda, Levallois flaking follows a particular volumetric concept of the core that consists of the preparation of two asymmetric convex surfaces defining a plane of intersection. One serves as a striking platform from which the other is flaked. Boëda identifies two methods of exploitation in the Levallois system: the preferential and recurrent methods (Boëda 1986, 1995a). Following him, we recognize six types of Levallois core (Fig. 7.1). The Levallois flakes are defined according to the classical definition of Bordes (1980):

1.A. In the preferential Levallois method, a single flake is manufactured from each prepared flaking surface and it removes most of this surface:
- 1.A.1: Preferential quadrangular Levallois core.
- 1.A.2: Preferential triangular Levallois core.

1.B. In the recurrent Levallois method, a series of flakes is manufactured from each prepared removal surface:
- 1.B.1: Recurrent unipolar Levallois core. Flakes are detached from a single striking platform. The negative removals visible on the upper surface have parallel or convergent directions.
- 1.B.2: Recurrent bipolar Levallois core. A series of predetermined flakes is derived from two opposed striking platforms; the negative removals visible on the upper surface of the core have parallel and opposed directions.
- 1.B.3: Recurrent centripetal Levallois core. The circumference of the entire surface of the core is used as the striking platform. For each preparation of the core, a series of centripetal flakes is detached.

1.C. Indeterminate Levallois core. These are broken or burnt items on which the flaking method cannot be defined.

There are no laminar Levallois cores in the 'transitional' assemblages.

Laminar flaking

Blade production displays 'Upper Palaeolithic' features in the flaking organization of the cores, such as in the convexity of preparations (*i.e.*, the preparation of crests, edge abrasion and removal of core tablets for platform maintenance and rejuvenation) and the common use of soft stone or soft hammer techniques. The identification of these techniques is based on criteria defined after knapping experiments (Pelegrin 1997). Blades can be produced from cores with one or more striking platforms. We present here the main categories of the blade cores that we have defined, according to the location of both the striking platforms and the removal surface of the cores. When flaking affects the lateral, widest part of the core, we call it a 'lateral-flaking core'. When it is restricted to the narrowest part of the core, we call it an 'axial-flaking core'. And when two striking platforms are involved, which are oriented on different axes of the core, we call it a 'twisted, two striking platform core'. We recognize eight types of Upper Palaeolithic blade cores (Fig. 7.2):

2.A. Single striking platform blade cores
- 2.A.1: Lateral flaking core with one striking platform. The lateral flaking starts from the narrow axis edge and extends towards the lateral, widest part of the core. The edge commonly has a natural, dihedral morphology as do flake cores, and thus cresting is unnecessary.
- 2.A.2: Axial flaking core with one striking platform. Flaking is restricted to the narrow axis of the core, but can extend a little towards the two lateral sides, and the striking platform is always oriented on the same axis of the core. Thus the specific location of the platform, in relation to the axis, remains unchanged throughout the whole knapping process.
- 2.A.3: Pyramidal or semi-pyramidal core. The core has a pyramidal shape and the removal of blades affects mostly the periphery of the core. When the removal of the blades affects only half of the periphery of the core, we call it a semi-pyramidal core.

2.B. Two opposed striking platforms oriented on the same axis blade cores
- 2.B.1: Opposed, lateral striking platform core oriented on the same axis. The lateral flaking starts from the narrow axis edge and extends towards the lateral edge of the core, which is always the widest part. Only one striking surface is exploited and the series of blades are removed alternately from the two opposed striking platforms.
- 2.B.2: Axial flaking core with two opposed platforms. Flaking is restricted to the narrow axis of the core, but can extend a little towards the two lateral sides. Thus, the specific location of the platforms, in relation to the axis, remains unchanged throughout the whole knapping process. Series of blades are removed alternately from the two opposed striking platforms.

2.C. Twisted opposed platforms blade cores
- 2.C.1: Axial flaking opposed to lateral flaking core. The striking surface is divided into two unequal flaking surfaces, which have opposite flaking directions. The axial flaking surface is usually the main one, as it covers most of the

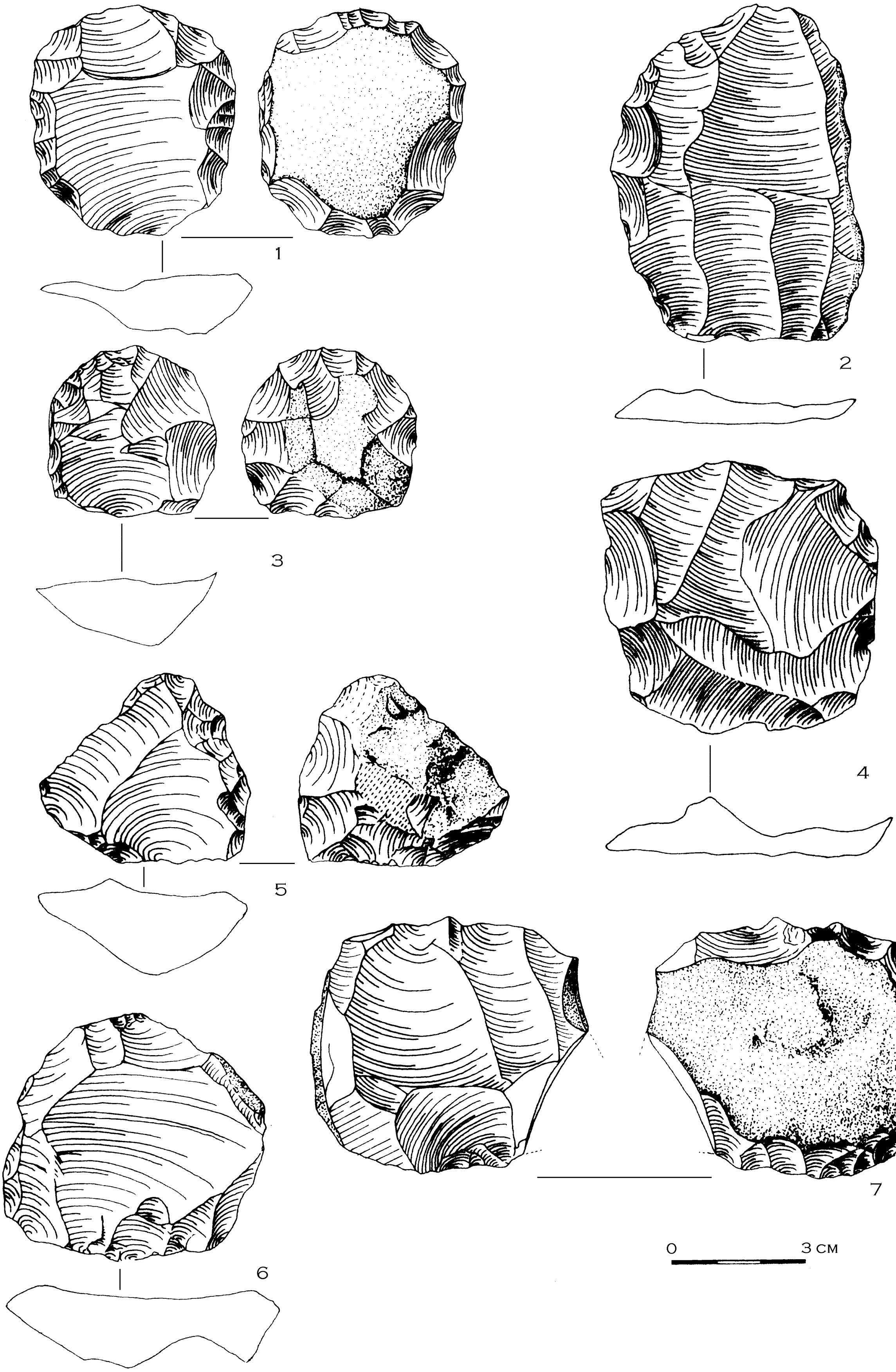

Fig. 7.1 Levallois core types: 1, Preferential flake core (Emireh); 2, Recurrent bipolar core (el-Wad F); 3, Recurrent centripetal core (Emireh); 4, Recurrent centripetal core (el-Wad F); 5, Recurrent unipolar core (Raqefet VII); 6, Recurrent bipolar core (Raqefet VII); 7, Recurrent unipolar core (Kebara E).

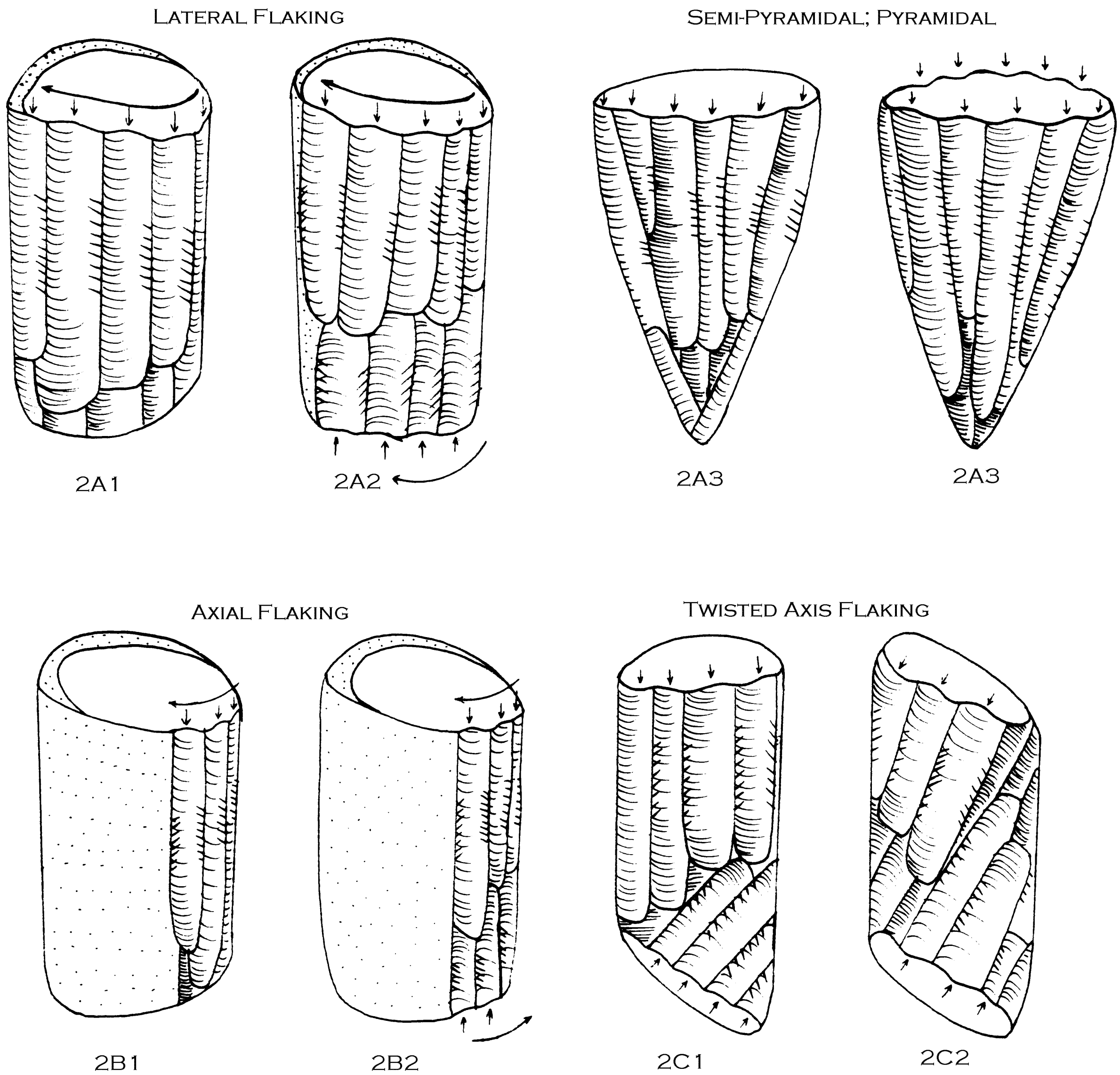

Fig. 7.2 Schematic illustrations of blade core categories: 2A1, Lateral core with single striking platform; 2A2, Axial core with single striking platform; 2A3, Pyramidal and semi-pyramidal cores; 2B1, Lateral, opposed platform core oriented on the same axis; 2B2, Opposed platform core oriented on the same axis; 2C1, Twisted opposed platform core with axial flaking opposed to lateral flaking; 2C2, Twisted opposed platform core with opposed lateral flaking.

removal surface and the lateral flaking surface is restricted to a small part of the striking surface. These two flaking surfaces maintain lateral and distal convexities, permitting more efficient blade production.

2.C.2: Bi-directional, opposed lateral flaking core. The removal surface is divided into two equal portions, which have opposed flaking directions. The two flaking surfaces maintain lateral and distal convexities, enabling more efficient blade production.

2.D. Indeterminate blade core. These are broken or burnt items for which the flaking method cannot be defined.

The 'Transitional' Phase at Raqefet

Raqefet Cave is situated in a west-facing cliff above Nahal Raqefet, Mount Carmel, Israel. Noy and Higgs excavated the site in 1970–72. Unfortunately, Noy did not complete her analyses of the material. Nevertheless, Noy and Higgs prepared a detailed report on the excavations, which is used in the present study (Noy and Higgs unpublished report).

The karstic cave consists of a chamber about 45 m long and 17 m wide, leading to a rear chamber *ca.* 8 m long and 13 m wide (Fig. 7.3). The cave has been eroded from a vertical joint and there is a chimney in the rear chamber that breaks through to the surface. A large rock-

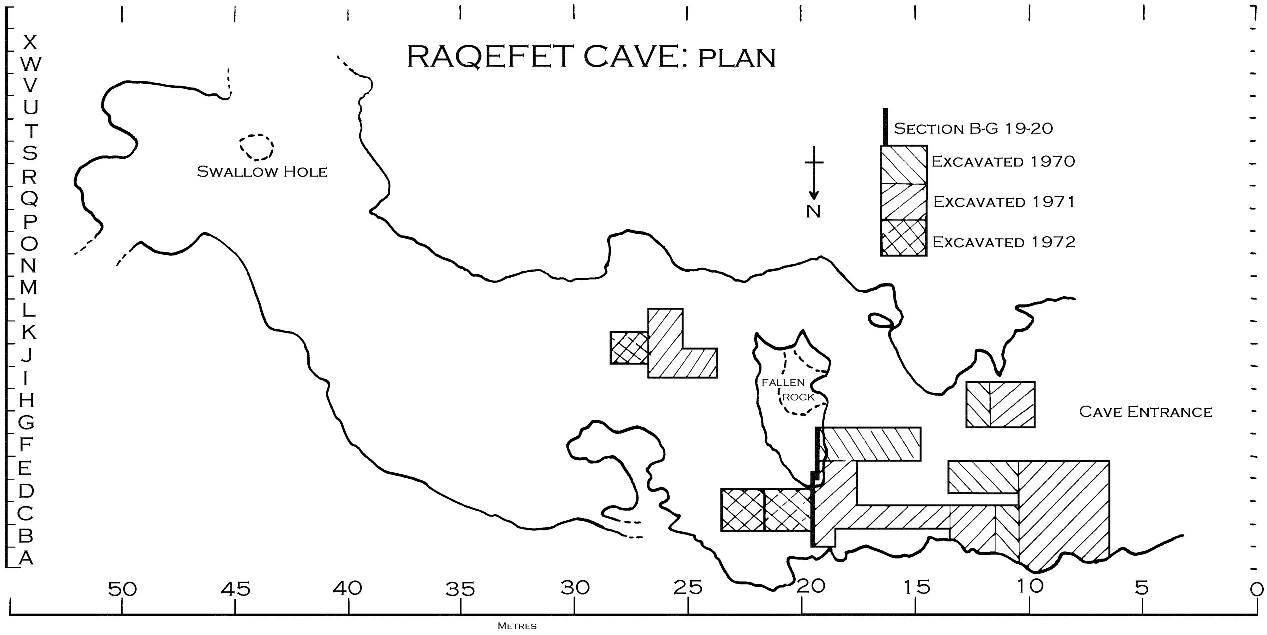

Fig. 7.3 Plan of the Raqefet excavations (after Noy and Higgs unpublished report).

fall has blocked off much of the light to the rear half of the site.

The site extends over a maximum area of some 500 m². The excavations were largely confined to the front chamber of the cave and divided into three areas (B-G/18–23, A-H/7–17 and J-M/24–28). The excavators were unable to establish stratigraphic correlations between these areas. The surface of the excavations amounted to 55 m² with a maximum depth of about 2.5 m. The three areas yielded Neolithic, Natufian and Kebaran occupations, but only squares C-D/18–20 and E-F/18–19 from the area B-G/18–23, were excavated down to bedrock, revealing four 'transitional' layers (VIII–V), 40–60 cm thick, which underlie two Upper Palaeolithic layers (IV–III). We assigned the four lower layers (VIII–V), which contain Mousterian implements associated with a blade-oriented technology to the 'transitional phase'. Layers IV–III were attributed by the excavators to the Levantine Aurignacian on the basis of the presence of typical Aurignacian tools (nosed, shouldered and carinated scrapers) and by the absence of Levallois implements.

The stratigraphy of Raqefet is very complex. The cave shows evidence of heavy erosive activity and the burrows present in some squares seem to have influenced the composition of the layers. The majority of flint shows varying degrees of abrasion, and in some squares (especially in squares D-E/19–20) concentrations of lithic material occur. This suggests that water and/or rodent burrowing have displaced some artefacts. In all layers there is burnt material.

Degree of Artefact Abrasion

In order to determine the effects of erosion on the artefacts in Raqefet in the 'transitional' layers, the tools, debitage and cores from area B-G/18–23 were divided into three abrasion categories:

A. Heavily rolled material. The artefacts are rounded and the scar removals are not visible.
B. Abraded material with strong patination. However, the material is not rounded and removal scars are still clear.
C. Fresh, unpatinated material.

For the purposes of this analysis, we considered the frequency of each abrasion group in different squares from each level. Both fresh and rolled implements are present in each square of all four layers. The most noteworthy observation concerns the relative proportions of the three preservation categories between the laminar and Levallois products, which do not change significantly within each layer; they have more or less comparable percentages in the different squares of the same layer, except for Square D20 in layer VII. Nevertheless, the relative frequencies of the three types do change from one layer to the next. The percentage of fresh implements tends to increase from bottom to top (17.6% in layer VIII, 47.5% in layer VI and 61.2% in layer V) (Table 7.1) and the Aurignacian layers (IV and III) contain only fresh material. Square D20, which yielded large quantities of artefacts, contains more rolled material in layer VII, when compared with the material from the other squares of the same layer. It

Table 7.1 Frequency distributions of the degree of abrasion of artefacts from Raqefet Cave.*

Category/Layer	Raqefet VIII	Raqefet VII	Raqefet VI	Raqefet V	Total
n =	295	2,612	1,045	609	4,561
Heavily rolled	18.3	28.1	15.8	6.2	21.8
Abraded	64.1	52.0	36.7	32.5	46.7
Fresh, unpatinated	17.6	19.8	47.5	61.2	31.6

*The artefacts include tools, debitage and cores

Table 7.2 Frequencies of Levallois, laminar, and non-Levallois tools in the 'transitional' layers of sites in northern Israel.

Tools	Raqefet VIII	Raqefet VII	Raqefet VI	Raqefet V	Emireh	Kebara E	el-Wad F2
n =	209	1,901	670	309	320	103	136
A	38.8	26.0	24.6	24.9	24.1	14.6	57.4
B	28.2	30.5	36.0	34.3	55.3	52.4	35.3
C	31.1	41.1	37.5	39.2	20.6	30.1	7.5
D	1.9	2.1	1.9	1.6	0.0	2.9	0.0

Key: A, Levallois tools; B, Blade tools; C, Non-Levallois flake tools; and D, Indeterminate

thus seems that the disturbance is most pronounced in the lower layers (VIII and VII).

Despite the lack of geological data, we can suppose that erosion and karstic activities occurred during the 'transitional' phase in Raqefet. The degree of abrasion is similar in both laminar and Levallois products, while the distributions of the Middle and Upper Palaeolithic type implements remain more or less constant in the different squares and layers.

Lithic Industries from the 'Transitional' Phase: Layers VIII–V

The 'transitional' layers are marked by the presence of Levallois methods, as well as non-Levallois flake and blade reduction strategies. The percentages of Levallois and blade tools remain more or less constant in the three 'transitional' upper layers of Raqefet (Layers VII–V). In Layer VIII, Levallois tools outnumber blade tools (Table 7.2).

In all these layers blade cores dominate. Their frequencies, which remain more or less constant in Layers VIII–VI with *ca.* 40%, attain 62.5% in Layer V. The Levallois cores account for *ca.* 30% in Layers VIII–VI, but they decrease in Layer V, with 12.5% (Table 7.3).

Levallois Flaking (Table 7.4): the preferential Levallois method is well represented amongst the Levallois cores (23.6%) in the 'transitional' layers. Among the preferential Levallois cores, the quadrangular flake cores are the main group, while triangular flake cores are poorly represented. However, it is the recurrent Levallois cores that are always dominant in these layers. Among them, recurrent unipolar cores represent 47.1% (Fig. 7.1:5), the recurrent centripetal cores 20.6%, and the bipolar cores 5.9% (Fig. 7.1:6). According to the flake scar orientations on some flakes, it is likely that some recurrent convergent unipolar Levallois cores were further reduced through a centripetal method toward the end of their exploitation. Some Levallois cores are broken or burnt and the flaking method cannot be defined. Side-scrapers, points and denticulates are the main tool types among the Levallois blanks.

Laminar Flaking (Table 7.5): there is no significant difference among the 'transitional'layers except for the single striking platform cores, which slightly dominate in the three upper layers (*ca.* 55%), especially the axial flaking core with one platform (31.2%). The lateral flaking cores with one platform are well represented (24.1%) and pyramidal or semi-pyramidal cores are rare. Opposed platform cores dominate in Layer VIII (56%). Two twisted striking platform cores with axial flaking opposed to lateral flaking, are well represented (26.8%) (Fig. 7.4:3). The opposed platform core, oriented on the same axis, also occurs (12.5%) (Fig. 7.4:1). The core can be on a flake, in which case the flaking is restricted to the side of the flake (Fig. 7.4:5). The bi-directional opposite lateral flaking cores (0.9%) and the lateral flaking on opposed striking platform core, oriented on the same axis (1.8%), are poorly represented.

It is worth noting the relation between the morphology of the blanks and the flaking method. Rounded nodules are the raw material generally selected for the one or two

Table 7.3 Levallois, laminar and non-Levallois cores in the 'transitional' layers of Raqefet.

Types	Raqefet VIII		Raqefet VII		Raqefet VI		Raqefet V		Total	
	N	%	N	%	N	%	N	%	N	%
1	7	33.3	37	23.9	21	32.8	3	12.5	68	25.8
2	9	42.9	62	40.0	26	40.6	15	62.5	112	42.4
3	5	23.8	47	30.3	13	20.3	5	20.8	70	26.5
4	0	0.0	9	5.8	4	6.2	1	4.2	14	5.3
Total	21	100.0	155	100.0	64	99.9	24	100.0	264	100.0

Key: 1, Levallois cores; 2, Non-Levallois blade cores; 3, Flake cores; 4, Indeterminate cores

Table 7.4 Levallois core categories in the 'transitional' layers of Raqefet.

Types	Raqefet VIII		Raqefet VII		Raqefet VI		Raqefet V		Total	
	N	%	N	%	N	%	N	%	N	%
1A1	1	14.3	8	21.6	5	23.8	1	33.3	15	22.1
1A2	0	0.0	1	2.7	0	0.0	0	0.0	1	1.5
1B1	3	42.9	19	51.3	8	38.1	2	66.6	32	47.1
1B2	0	0.0	2	5.4	2	9.5	0	0.0	4	5.9
1B3	3	42.9	6	16.2	5	23.8	0	0.0	14	20.6
1C	0	0.0	1	2.7	1	4.8	0	0.0	2	2.9
Total	7	100.1	37	99.9	21	100.0	3	99.9	68	100.1

Key: 1A1, Preferential quadrangular flake core; 1A2, Preferential triangular flake core; 1B1, Recurrent unipolar core; 1B2, Recurrent bipolar core; 1B3, Recurrent centripetal core; 1C, Indeterminate core

Table 7.5 Laminar core categories in the 'transitional' layers of Raqefet.

Types	Raqefet VIII		Raqefet VII		Raqefet VI		Raqefet V		Total	
	N	%	N	%	N	%	N	%	N	%
2A1	1	11.1	16	25.8	6	23.1	4	26.7	27	24.1
2A2	3	33.3	20	32.3	8	30.8	4	26.7	35	31.2
2A3	0	0.0	0	0.0	1	3.8	0	0.0	1	0.9
2B1	1	11.1	0	0.0	1	3.8	0	0.0	2	1.8
2B2	2	22.2	7	11.3	4	15.4	1	6.7	14	12.5
2C1	2	22.2	17	27.4	6	23.1	5	33.3	30	26.8
2C2	0	0.0	1	1.6	0	0.0	0	0.0	1	0.9
2D	0	0.0	1	1.6	0	0.0	1	6.7	2	1.8
Total	9	99.9	62	100.0	26	100.0	15	100.1	112	100.0

Key: 2A1, Lateral flaking core with single striking platform; 2A2, Axial flaking core with single striking platform; 2A3, Pyramidal or semi-pyramidal core; 2B1, Lateral opposed platform core oriented on the same axis; 2B2, Opposed platform core oriented on the same axis; 2C1, Twisted opposed platform core with axial flaking opposed to lateral flaking; 2C2, Twisted opposed platform core with bi-directional opposed lateral flaking; 2D, Indeterminate blade core.

opposed striking platform core with twisted-axes. Tabular flint or thick flakes are most often used for the one or two opposed striking platforms with axial flaking or lateral flaking cores. According to the scars visible on some striking platforms and the orientation of the blade removals, it seems that products were more frequently removed by soft or soft stone hammer in a tangential motion. On some cores, the use of both a hard and soft stone hammer is likely, and can be connected with different sequences in the reduction strategy. The blade tool assemblage consists of high frequencies of retouched pieces, notches and denticulates, as well as simple endscrapers, truncated pieces and perforators. The el-Wad points, burins, carinated and nosed endscrapers occur in a low frequency. Bladelets are poorly represented, accounting for 1.8% of the tools, representing mainly retouched bladelets, endscrapers and truncated bladelets.

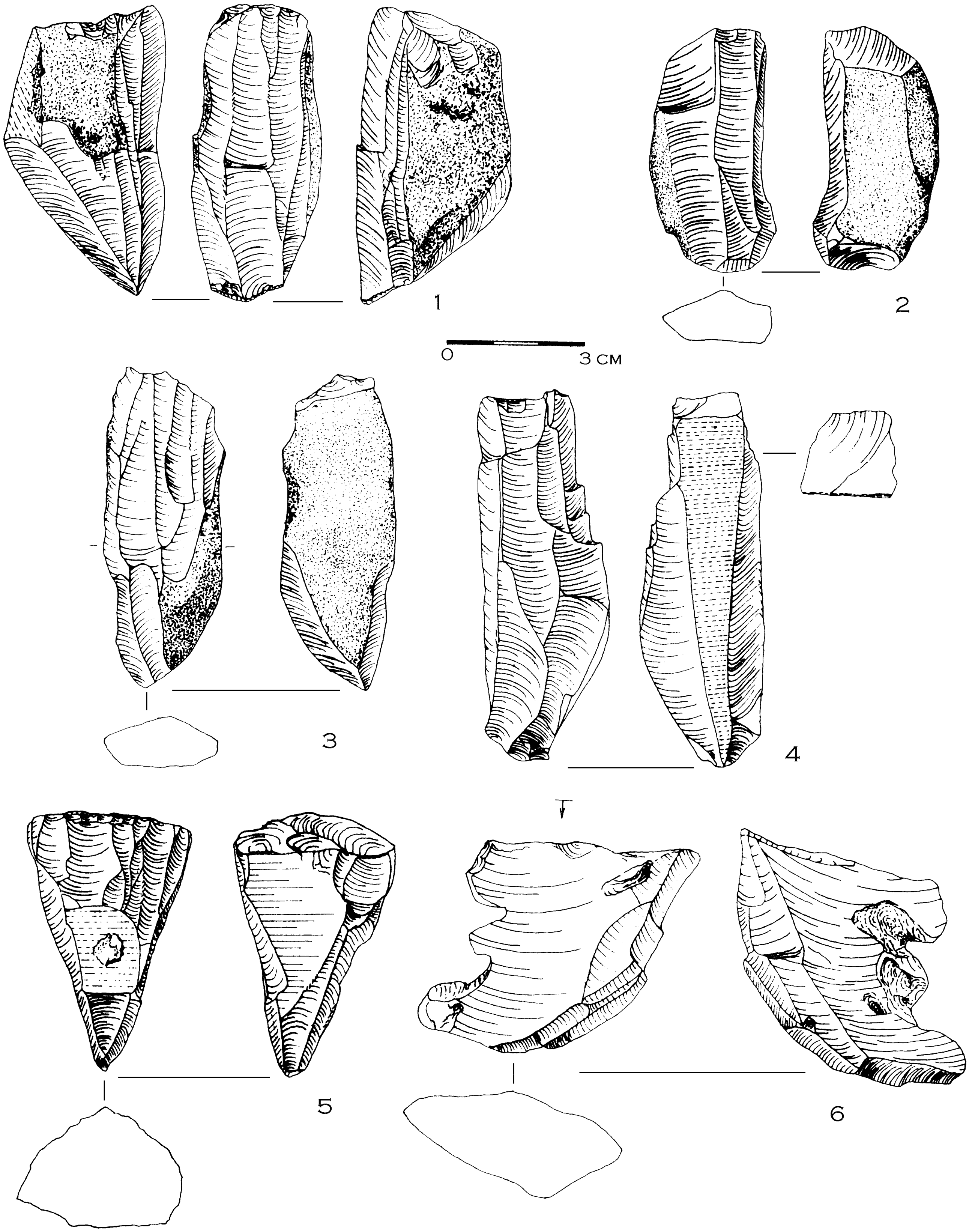

Fig. 7.4 Blade core types: 1, Opposed platform core oriented on the same axis (Raqefet VIII); 2, Twisted opposed platform core with axial flaking opposed to lateral flaking (el-Wad F); 3, Twisted opposed platform core with axial flaking opposed to lateral flaking (Raqefet VII); 4, Twisted opposed platform core with axial flaking opposed to lateral flaking (Emireh); 5, Semi-pyramidal core (Kebara E); 6, Opposed platform core oriented on the same axis (on flake, Raqefet VIII).

Emireh

Emireh Cave is located in the Rift Valley, lower Galilee, Israel. The site revealed a Palaeolithic layer covered by some Neolithic remains and recent deposits. The sediments, which averaged 70 cm in thickness, extended in part down to bedrock. Garrod, who published the material, assigned it to the 'transitional' Emiran industry (Garrod 1955). The total collection includes 706 pieces. For this study, 657 implements were examined from the Rockefeller Museum, as well as a small sample kept in the Institut de Paléontologie Humaine in Paris.

Levallois Flaking: of the 37 cores, 16 (43%) are of Levallois type. The recurrent centripetal Levallois method is dominant among the Levallois cores (Fig. 7.1:3). Products of preferential Levallois flake cores (Fig. 7.1:1) and of the recurrent, mostly convergent, unipolar cores occur, but the recurrent bipolar Levallois method is absent. The assemblage contains 24.1% Levallois tools (Table 7.2). Sidescrapers, points and denticulates are the main tool types. Four Emireh points are present in this assemblage.

Laminar Flaking: of the 37 cores, 17 (46%) were used to produce blades. Among the laminar cores, blade production from two striking platform cores dominates, particularly those with twisted axial flaking opposed to lateral flaking (Fig. 7.4:4). Semi-pyramidal or pyramidal cores are also present. The lateral flaking type is poorly represented. Blade blanks generally have small plain butts, with traces of abrasion on the edge, indicating the use of a soft or soft stone hammer. Among the 320 tools examined in this assemblage, the laminar index forms 55.3% (Table 7.2). Narrow blades and bladelets have been made into endscrapers, el-Wad points or retouched tools. Large blade points, denticulates, sidescrapers and endscrapers have been manufactured on large triangular blades with facetted butts. It is possible that these blanks were removed from pyramidal cores by direct percussion using a hard stone hammer.

El-Wad

El-Wad Cave is located in Wadi el-Mughara, Mount Carmel. The excavations, which took place in the cave and on the terrace, revealed an important succession of layers. Garrod first interpreted the sequence as Mousterian (layer G) covered by Upper Palaeolithic deposits (layers F, E, D and C). Later, she changed her interpretation and assigned layers G and F to a single cultural unit defined as a 'transitional' industry (Garrod and Bate 1937; Garrod 1951:121–130). The material from el-Wad is stored in different museums all over the world. For this study, the implements stored in the Rockefeller Museum in Jerusalem, and at the Institut de Paléontologie Humaine in Paris were examined. Only the results from the analysis of layer F2 are presented here, which constitutes a small part of the assemblage. Of 1,056 pieces from F2, we examined 198 tools and cores, which represent 18.8% of Garrod's collection. This assemblage consists of blades and Levallois products, with the presence of the Emireh point. The predominant raw material in this industry occurs in the form of medium or small nodular flint of local origin, less frequently on large nodules or pebbles. All of these were used for the production of both Levallois and laminar blanks.

Levallois Flaking: among the 62 cores, 47 (76%) are Levallois. The Levallois debitage of preferential flake core type dominates. The recurrent centripetal (Fig. 7.1:4) and unipolar convergent cores are well represented. The recurrent bipolar Levallois method also occurs (Fig. 7.1:2). Levallois tools represent 57.4% of the tools examined. Sidescrapers, denticulates, and retouched flakes are well represented among the tools. Garrod reported five Emireh points in el-Wad G-F (Garrod 1955:142)

Laminar Flaking: of the 62 cores, 13 (21%) were used to produce blades. The nodules are generally smaller than those from Emireh. They are most often rounded and cortical. Among the laminar cores, two striking platform varieties are well represented, especially those with twisted axial flaking opposed to lateral flaking (Fig. 7.4:2). Lateral flaking cores occur, and the semi-pyramidal or pyramidal cores are poorly represented. Laminar tools form 35.3% of the sample. Among the 48 tools examined, denticulates and retouched blades are well represented. The blade blanks generally have small plain butts, with traces of abrasion on the edge, attesting to the use of a soft or soft stone hammer utilized in a tangential motion.

Kebara

The cave, situated in Mount Carmel, has been excavated several times and is a key site for defining the cultural sequence of the Upper Palaeolithic in the Levant. The excavations revealed Early Natufian, Kebaran (Turville-Petre 1932; Garrod and Bate 1937), later Upper Palaeolithic (Garrod 1954), and Mousterian layers (Schick and Stekelis 1977). More recently, the site has been re-excavated with greater stratigraphic precision (Bar-Yosef *et al*. 1992, 1996; Goldberg and Bar-Yosef 1998). Four Upper Palaeolithic units were distinguished overlying the Mousterian. Units III–IV were assigned to the Ahmarian, and Units I–II to the Levantine Aurignacian (Bar-Yosef and Belfer-Cohen 1996).

We present here a sample of the Upper Palaeolithic assemblage (layer E) from the Turville-Petre excavation. This assemblage of 469 items was divided in 1931 into three approximately equal lots (Garrod 1954:156). A lot of 137 items housed at the Rockefeller Museum was examined here.

The sample contains both Levallois flakes and Upper Palaeolithic blades. The Levallois tools comprise 14.6% and the blade tools 52.4% of the assemblage (Table 7.2).

Of the 22 cores, two are Levallois cores (9.1%), 19 are blade cores (86.4%) and one is a non-Levallois flake core (4.5%). According to the blade industry that characterizes this assemblage, Bar-Yosef *et al.* (1996:302) suggest that layer E should be correlated with Units IV and III of the new excavations.

Levallois Flaking: only two cores were found in this assemblage. One is a recurrent unipolar (Fig. 7.1:7) and the other is a preferential Levallois core. Among the tools on Levallois flakes, points and sidescrapers dominate.

Laminar Flaking: among the laminar cores, blade production from two platform cores represent 48%. The axial double core with one striking platform and the two twisted striking platform cores with axial flaking opposed to lateral flaking dominate. The semi-pyramidal or pyramidal cores are well represented (Fig. 7.4:6), while lateral flaking hardly occurs. Among the tools on blade/lets examined, points, endscrapers and retouched blades are the main tool types. The blade blanks generally have small plain butts, with traces of abrasion on the edge. It seems that the products from layer E were more frequently removed by soft stone hammer, or soft hammer.

Ksar Akil

Ksar Akil is a rockshelter situated in Wadi Antelias in Lebanon. The site was discovered in 1922 and excavated in 1937–38 under the direction of J.G. Doherty from Boston College, Massachusetts, then in 1947–48 by J.F. Ewing who established a stratified sequence of 34 levels (Ewing 1947; 1949), and later, in 1969–75, by J. Tixier (1974). The site of Ksar Akil revealed 22 m of archaeological deposits, beginning with Mousterian levels and ending with Kebaran strata. The Middle to Upper Palaeolithic transitional layers (XXV–XIV) yielded about 4 m of deposits, including both Levallois implements and Upper Palaeolithic blades. These levels were divided into Phases A and B (Copeland 1975; 1986). We studied samples of 374 cores from the Doherty and Ewing excavations housed in the British Museum, London and present here the preliminary results. This material was studied previously by Azoury (1986) and Ohnuma (1988).

Phase A (levels XXV–XXI) overlies the Mousterian levels and contains Levallois and non-Levallois laminar products. Among the 289 cores examined from Phase A, 10.7% are Levallois cores, 79.2% are laminar cores and 10.0% are other flake cores. The recurrent unipolar Levallois method is mostly used and recurrent bipolar Levallois cores are well represented. Blade production from single platform cores is dominant. Axial flaking cores dominate and pyramidal and semi-pyramidal cores are present. The technique used is essentially hard hammer. The main tools are elongated triangular points, endscrapers and chamfered blades. Levallois points, sidescrapers, notches and denticulates are poorly represented (Azoury 1986; Ohnuma 1988).

Phase B (levels XX–XIV) underlies the Aurignacian layers from which it is separated by the artefact-poor level XIV. Azoury divided this phase between Phase IIA (levels XX–XIX) and Phase IIB (levels XVIII–XV), according to the presence or absence of tools such as the el-Wad point (Azoury 1986). Among the 85 cores examined from Phase B, 9.4% are Levallois cores, 85.9% are laminar cores and 4.7% are other flake cores. These levels exhibit both Levallois and blade implements. Nevertheless, some technological and technical differences with Phase A can be noticed. The blades are detached mostly from opposed platform cores and the bipolar cores with twisted-axes dominate. Pyramidal or semi-pyramidal cores are not represented. Moreover, soft hammer was used for detaching blades. The main tools are endscrapers and el-Wad points; notches and denticulates occur but chamfered pieces are absent (Azoury 1986; Ohnuma 1988).

According to these preliminary results, it seems that the assemblages of Phase B exhibit similar features to those from northern Israel. We describe below the main characteristics of these assemblages.

Characteristics of the Northern 'Transitional' Industries

Raqefet VIII–V, Emireh, el-Wad F, Kebara E and Ksar Akil Phase B, have yielded assemblages sharing a number of features, such as the association of Upper Palaeolithic blade and Levallois products and similar reduction strategies. In all these assemblages, the preferential and recurrent unipolar methods are mainly used among the Levallois cores; and the twisted platform cores with axial opposed to lateral flaking are mostly dominant among the laminar cores. The single platform core with axial flaking is also well represented. The methods used to produce blades are most often related to the morphology of the raw material. Lateral and axial flaking is frequently used with flat nodules, tabular flint or thick flakes, while twisted axial flaking is employed for the rounded nodules. The Levallois blanks were usually used to produce sidescrapers, endscrapers, points, denticulates and retouched flakes. The blade tool components usually consist of retouched blades, notches and denticulates, endscrapers and points. The laminar products indicate the use of hard and soft hammer or soft stone hammers.

The 'Transitional' Industries from Boker Tachtit

Boker Tachtit is situated on the east bank of Nahal Zin in the central Negev, Israel. The site was excavated in 1975 and 1980 (Marks 1977a, 1983a). Four occupation layers have been observed. Levels 1–3 have been related to the 'transitional' phase and level 4 (the uppermost layer) to the Upper Palaeolithic (Marks and Volkman 1983; Marks and Kaufman 1983). Systematic core reconstruction has enabled the determination of the main reduction strategies

employed in these four levels. They attest to a period of rapid technological change from a specialized Levallois-based core reduction strategy to a single platform core reduction strategy (Volkman 1983). This change consisted of a shift from a homogeneous Levallois-based technology (level 1) to a period of great heterogeneity and flexibility in technology (levels 2 and 3), ending with another homogenous, but non-Levallois based, single platform blade technology (level 4) (Volkman 1983:130). We examined a sample of 115 cores from Boker Tachtit housed at the Israeli Antiquities Authority, and we present here the preliminary results.

In the three transitional lower levels (1–3), opposed platform cores dominate. Most of them exhibit opposed striking platforms oriented on the same axis. Also present, to a lesser degree, are twisted striking platform cores with axial opposed to lateral flaking. The uppermost level (4) exhibits different reduction strategies. The axial-flaking blade core with single platform dominates and the pyramidal core occurs. Most cores from these four levels display preparation of crested blades and the hard hammer percussion technique is used exclusively.

The 'transitional' industries from Lebanon, northern and southern Israel display both Levallois implements and Upper Palaeolithic blades. Are the Levallois and blade flaking methods in the north (including Ksar Akil) similar to those from Boker Tachtit? Are the north and the south culturally related?

Lebanon, Northern and Southern Israel 'Transitional' Industries Compared

The main difference between the assemblages in the north (including Ksar Akil) and the south concerns the Levallois reduction strategies. The northern industries exhibit Levallois cores compatible with Boëda's definition. This is not the case at Boker Tachtit. Using Bordes's definition of Levallois, Marks and Kaufman suggest that in Boker Tachtit '… the basic core reduction method is Levallois, in as much as there apparently was a desired end product of predictable shape; a shape predetermined by prior removals' (Marks and Kaufman 1983:71). These cores described as Levallois show two main differences in reduction strategies in comparison to the other sites studied herein:

First, in the northern Levallois assemblages, the organization of the Levallois debitage always follows a particular volumetric concept of the core. The initialization phase prepares the core volume, comprising two asymmetric convex surfaces that form a plane of intersection. In order to create the convexities that permit detachment of the Levallois blank(s), the knapper removed *débordant* flakes or centripetal predetermining flakes, which are always secants to the intersection plane and are removed from the lateral and distal sides of the core (Boëda 1986, 1995a). In the Levallois cores from Boker Tachtit 1–3, the initialization phase is marked by the production of one or two crests situated on the upper and/or lower surfaces. The predetermining flakes that form the crest are not detached from the lateral or distal sides, as with the northern Levallois cores but from the upper side, along the long axis of the core.

Secondly, in the northern Levallois cores, the large surface of the core is selected as the flaking surface. In the Levallois cores from Boker Tachtit, the flaking surface is always the narrow side of the core. Because flaking is restricted to the narrow axis and the two striking platforms are oriented on the same axis, it is possible to consider them as axial flaking blade cores with two opposed platforms.

Among the Levallois cores of the north (including Ksar Akil), the recurrent centripetal and the unipolar types dominate, while they are totally absent in the south. One and two striking platform cores are well represented in the laminar cores of the northern industries. The twisted striking platform cores and the axial-flaking cores with one or two striking platforms dominate. Lateral flaking and the pyramidal cores occur less frequently. In Boker Tachtit levels 1–3 axial flaking blade cores with opposed platforms dominate. The single striking platform cores are less frequent and the twisted platforms core is absent.

Sidescrapers, points and denticulates constitute the main categories among the Levallois products of the northern assemblages; retouched blades, notches and denticulates are the main tool types among the laminar products. Some retouched bladelets occur in most of the assemblages. Levallois points, Emireh points, burins, notches and denticulates constitute the main tool types in Boker Tachtit levels 1–3. There are no bladelets or retouched bladelets at Boker Tachtit (Marks 1983a).

The techniques of soft or soft stone and hard hammer percussion are all attested in northern assemblages (including Ksar Akil), while at Boker Tachtit 1–4 only hard hammer percussion is used.

Conclusions

The northern and the Boker Tachtit assemblages presented herein have all been considered as 'transitional', since they display both Levallois and blade reduction strategies. Nevertheless, the technological differences described here lead us to suggest that it is not possible to relate the northern and southern industries to the same cultural entity. Even if we suppose that post-depositional processes did mix the Middle Palaeolithic and Upper Palaeolithic layers in the northern caves, the technological differences between the industries of the north and those of Boker Tachtit are still considerable.

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A special note of appreciation is due to the late Tamar Noy for granting us permission to work on the material from Raqefet and for giving us access to her valuable notes.

8. The Tor Sadaf Lithic Assemblages: A Technological Study of the Early Upper Palaeolithic in the Wadi al-Hasa

Jake R. Fox

Introduction

In recent years archaeological investigations into the earliest Levantine Upper Palaeolithic have taken on increasing importance. Sites dating to this interval are quite rare, and our understanding is further confounded by a lack of reliable dates from such sites. As a result, the technological variability and chronology for this important phase of human cultural evolution are poorly understood. Through the use of a detailed technological analysis, this paper introduces evidence from the site of Tor Sadaf into our current database and also provides new insights into the technological evolution from a transitional, single platform technology with a number of Levallois-like characteristics, to a true blade technology. Tor Sadaf can be added to the list of sites where this shift has now been documented (Azoury 1986; Coinman and Henry 1995; Marks 1983c; Ohnuma and Bergman 1990). In addition, the sequence of occupation at Tor Sadaf may represent one of the only sites where an Early Ahmarian assemblage is found stratigraphically overlying materials of a transitional nature.

The Site of Tor Sadaf

The rockshelter of Tor Sadaf was found during a survey of the north bank of the Wadi al-Hasa (Clark *et al*. 1992). The site consists of a small limestone overhang (extending less than 2 m from the parent rock), overlooking a tributary to the Wadi al-Misq (see Coinman this volume for map). The rockshelter overhang is formed on the strath bench of an extensive bed of fossil oystershell deposits (Schuldenrein in Olszewski *et al.* 1998). Lithic artefacts were concentrated on a relatively flat surface immediately below and in front of the rockshelter, extending down a steep talus to the nearby wadi bottom. In contrast to many Upper Palaeolithic sites in the Hasa area, Tor Sadaf is not located near the edge of the Pleistocene lake that dominated the larger Hasa Basin (Schuldenrein and Clark 1994). The distance to the main lake basin and the absence of lake sediments or remnant marls in the area of the site suggest that the site's function may relate to another sort of resource zone, but palaeoenvironmental evidence is fragmentary.

Investigations at Tor Sadaf were conducted over two seasons in 1997–98, as part of the Eastern Hasa Late Pleistocene Project (EHLPP) (Olszewski *et al*. 1998; Coinman *et al*. 1999). Excavation of eight 1 m^2 units (Fig. 8.1) took place in arbitrary 5 cm levels, and revealed over 1 m depth of *in situ* deposits, consisting primarily of chipped-stone tools and debitage, and faunal remains. Limestone bedrock was exposed at the base of excavation units located beneath the rockshelter overhang. Sediments are predominantly aeolian and colluvial, and consist of homogeneous fine-grained silty loam. Although some differentiation of 'natural' levels was possible, these levels could only be observed in profile walls of the excavation, and appear to represent minor variations in the continuous depositional sequence of the site. The only exception to this continuous sequence of fine-grained sediments was a surface layer (*ca*. 5 cm depth) of dense dung deposits from modern activity and the presence of a deeper layer (at *ca*. 1 m depth) of limestone boulders and large cobbles (the 'cobble-layer' in Coinman and Fox 2000)(Fig. 8.2).

The cobble-layer was observed only in units below the rockshelter overhang, and did not appear to extend into the open-air portions of the site. The stones making up this layer tend to be angular, relatively unweathered, and occur in association with high artefact densities. Although the distribution of these stones suggests that they may represent roof-fall, the stones do not contain fossilized oystershell remains, indicating that they do not originate from the rockshelter parent material. The stones of the cobble-layer appear to have more in common with some outcrops of limestone found upslope from the site, suggesting that they may have been transported from that location. All of this makes it tempting to interpret the cobble-layer as the remains of a cultural feature, but this suggestion is impossible to prove at this point. It remains possible that the cobble-layer originated from inclusions which fell from the rockshelter roof, although no such inclusions were observed in the parent material. In any case, the high density of artefacts associated with the

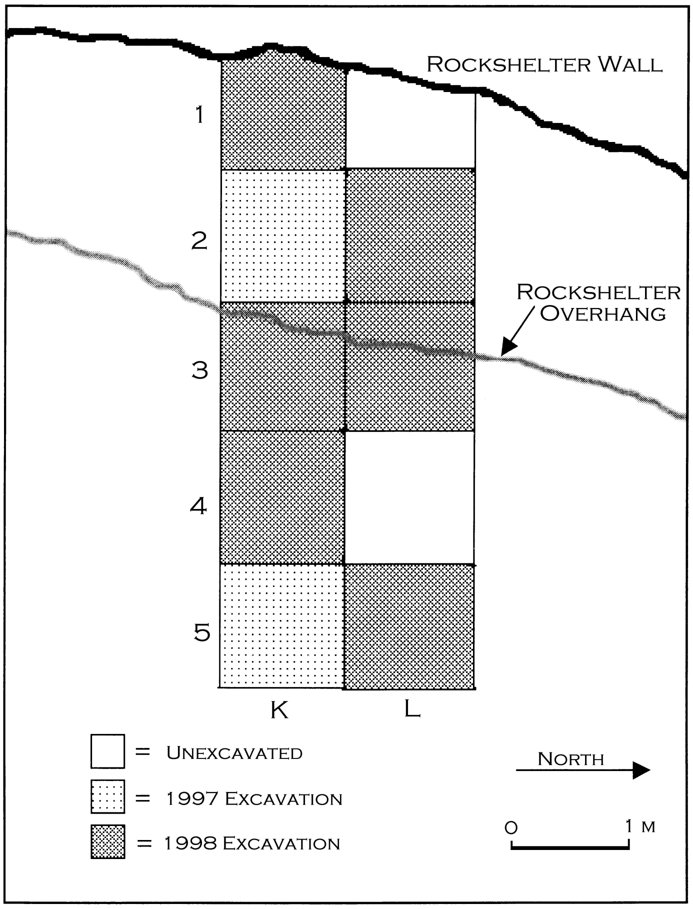

Fig. 8.1 Plan View of Excavation Units at Tor Sadaf.

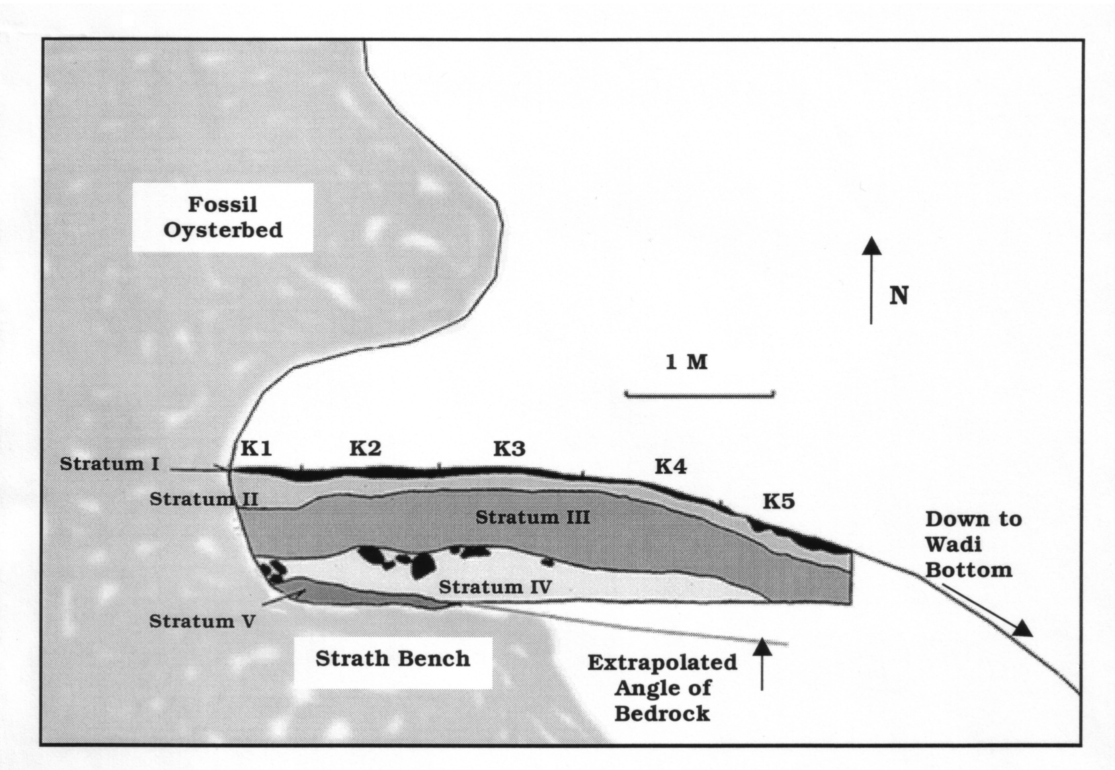

Fig. 8.2 Profile of the Tor Sadaf Rockshelter Showing 'Natural' Stratigraphy.

cobble-layer suggests that if this material represents a period of roof collapse, it must have occurred within a relatively short duration since sedimentation and artefact deposition show no evidence of interruption. Abundant archaeological remains were recovered throughout the vertical sequence at the site and, combined with the sedimentological observations, indicate that the deposits accumulated at a relatively steady pace, without the formation of discrete surfaces or floors.

Pollen analyses are still pending, but preliminary analysis of faunal remains suggested that they include large amounts of small and medium bodied taxa, including gazelle, tortoise and hare. These data contrast with many of the later Upper Palaeolithic faunal assemblages located closer to the palaeo-lakeshore where large bovid and equid species are more common (see Coinman this volume). Phytolith analyses show relatively high proportions of woody plant stems with low proportions of foliage[1]. These results combined with the faunal and sedimentological observations, suggest that the occupations at Tor Sadaf occurred during a relatively dry period in the Hasa area, and were also possibly keyed to a late fall or winter seasonal cycle. At this point, Tor Sadaf is the only well-studied Early Upper Palaeolithic site in the Wadi al-Hasa, making attempts at comparison limited to much later occupations, most of which occur within the main lake basin. Efforts at environmental study are also complicated by the lack of radiometrically datable material from Tor Sadaf, so that correlation with the existing chronology of lake activity and changing resource zones in the area is difficult to evaluate.

In general, the sedimentological and stratigraphic observations from the site suggest that the site witnessed a relatively continuous depositional sequence. There is no evidence of stratigraphic breaks or discontinuities in the stratigraphy of the site, suggesting that Tor Sadaf may also offer a glimpse of continuous cultural change over the course of occupation. This proposition is investigated in the analysis section.

Analysis of the lithic Assemblages

Methods of Analysis

Since the stratigraphy at Tor Sadaf is relatively homogeneous and preliminary analyses (Coinman and Fox 2000) suggested that there was no correspondence between minor changes in sedimentation and changes in lithic technology, analysis proceeded by first dividing the lithic materials according to technological and typological attributes. This approach was more useful than dividing the lithic materials by subtle (indeed, barely detectable in some units) changes in silt/sand/clay proportions, which provide the only means of differentiating most 'natural' levels in the site. In addition to the stratigraphic homogeneity of the site sequence, aspects of the lithic artefacts also suggest a continuous sequence of occupation and technological change. Fig. 8.3 shows a plot of artefact density in 5 cm excavation levels in unit K3. It can be seen that, although there are fluctuations in artefact density, there is no indication of a hiatus as artefact densities remain well over 100 per m^3 x .05 until the very uppermost level. Fig. 8.4 shows frequencies of flakes, blades and bladelets by arbitrary levels in unit K3. Again, although there are fluctuations from level to level, it can be seen that the overall trend is gradual, from a flake/large blade dominated assemblage to a bladelet-dominated assemblage. Similar trends of gradual change at the site have been illustrated elsewhere (Coinman and Fox 2000; Fox 2000).

Thus, in order to monitor technological change at the site, the lithic materials were divided into three stratigraphically related analytical units or 'occupation levels' on the basis of blank counts and platform attributes of blades. These three occupation levels form the basis of comparison for understanding change in lithic technology, and are designated (from latest to earliest): Early Upper Palaeolithic, Tor Sadaf B and Tor Sadaf A[2] (Fig. 8.5). Table 8.1 shows the correspondence between excavation units, arbitrary excavation levels, natural stratigraphy and analytic units (occupation levels). The use of the three analytic units has been discussed in detail elsewhere (Coinman and Fox 2000), so my discussion here will be limited to a few important points.

Given the nature of the undifferentiated sediments and high artefact densities throughout the arbitrary excavation levels and units at Tor Sadaf, I would argue that any temporal division of the lithic materials into discrete units is largely arbitrary. As the subsequent analyses show, the grouping of the materials from more than 20 arbitrary 5 cm levels in eight 1 m^2 units into three occupation levels has proved useful for identifying and examining technological and typological changes at Tor Sadaf (Fox 2000). It should be clear that the use of these three occupation levels is not intended to suggest discrete cultural phases. Rather, I have used these three occupation levels as a heuristic device to illustrate important changes in lithic technology over time.

Following initial sorting and counting of all lithic artefacts according to debitage and tool categories, the technological analysis proceeded in a number of steps. First, all cores (n= 196) were analyzed using a number of variables designed to illuminate technological variability and changes in reduction strategies. Following this, samples of blades and flakes were drawn from every arbitrary level and unit excavated at the site. In all, over 1,500 blades and flakes were sampled for detailed metric and attribute analysis, ensuring that all temporal and spatial aspects of the site's materials were included. Preliminary studies showed that blades were particularly useful for illuminating core reduction strategies, and so these pieces are the primary focus of debitage analysis in this study. Finally, a metric and attribute analysis focusing on retouched and unretouched points was

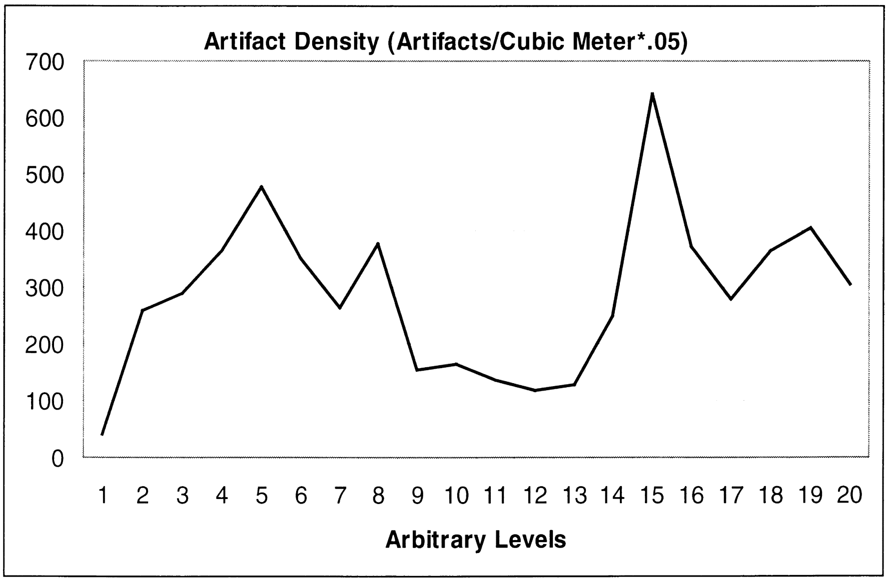

Fig. 8.3 Plot of Artefact Densities by Arbitrary Levels in Unit K3 at Tor Sadaf.

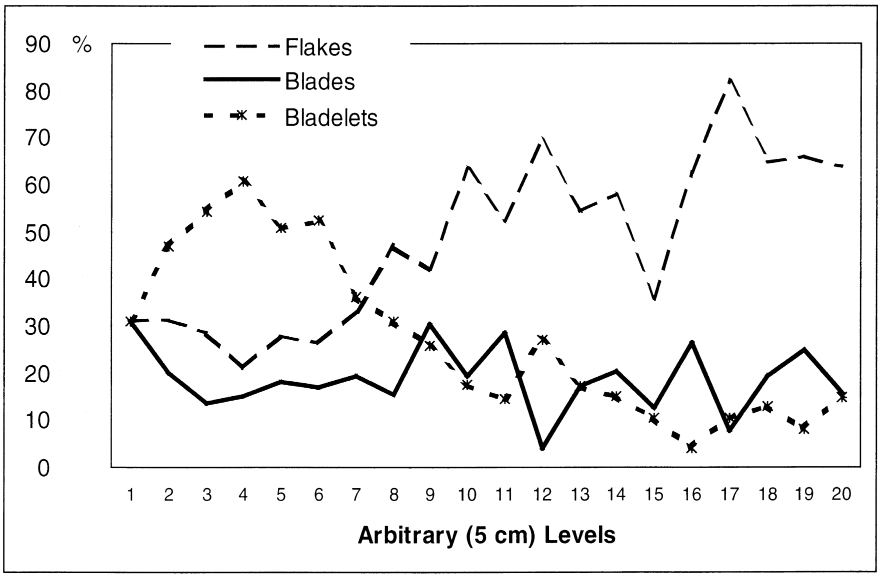

Fig. 8.4 Plot of Artefact Percentages by Arbitrary Levels in Unit K3 at Tor Sadaf.

performed, since these pieces represented the overwhelming majority of tools from the three assemblages. This sequence of analyses has provided an abundance of useful data for understanding changes in reduction strategies employed at Tor Sadaf.

The Tor Sadaf Lithic Assemblages

Across the three occupation levels at Tor Sadaf, the production of bladelets becomes increasingly important over time (Table 8.2). The increase in bladelet frequency comes at the cost of both flakes and blades. This trend culminates in the Early Upper Palaeolithic assemblage, where blades and bladelets comprise nearly 30% of the debitage recovered. The emphasis on blade production in the Early Upper Palaeolithic assemblage can likely be explained in reference to the abundance of tools on blade/bladelet blanks. Many of these blanks were modified into retouched bladelets and el-Wad points, a strong indicator of the Ahmarian character of the assemblage. In the

Table 8.1 Correspondence Between Natural and Arbitrary Levels in Excavation Units and Analytic Units (Occupation Levels) Used in the Analysis.

Stratigraphic Unit	Arbitrary Level by Excavation Units	Occupation Level
I, II, III (upper portion)	K1 (1–7), K2 (1–8), K3 (1–9), K4 (1–10), K5 (1–**11**), L2 (1–7), L3 (1–7), L5 (1–**13**)	Early Upper Palaeolithic
III (lower portion)	K1 (8–14), K2 (9–16), K3 (10–15), K4 (11–17), L2 (8–13), L3 (8–15)	Tor Sadaf B
IV	K1 (15–**18**), K2 (17–**20**), K3 (16–**20**), K4 (**18**), L2 (14–**17**), L3 (16–**20**)	Tor Sadaf A
V Sterile Oystershell Bedrock (Strath Bench)		
Note: Bold numbers indicate the lowest arbitrary level excavated.		

Table 8.2 Frequencies and Percentages of Lithic Artefacts by Occupation Periods from Tor Sadaf.

	Early UP		Tor Sadaf B		Tor Sadaf A		Total	
Debitage	n	%	n	%	n	%	n	%
Cores	87	0.8	59	1.4	50	1.4	196	1.0
CTE	117	1.0	38	0.9	23	0.7	178	0.9
Flakes	2546	22.6	1686	39.0	1426	40.3	5658	29.6
Blades	758	6.7	489	11.3	468	13.2	1715	9.0
Bladelets	2567	22.8	308	7.1	207	5.9	3082	16.1
Burin Spalls	21	0.2	10	0.2	10	0.3	41	0.2
Trimming/Retouch Flakes[a]	5163	45.6	1735	40.1	1356	38.3	8254	43.2
Total Debitage	11260	79.7	4325	69.4	3540	74.8	19125	76.2
Primary Elements[b]	628	5.6	230	5.3	199	5.6	1056	5.5
Debris	2518	17.8	1717	27.5	1071	22.7	5306	21.1
Tools								
Endscrapers	45	13.4	34	17.5	19	15.7	98	15.1
Burins	9	2.7	6	3.1	1	0.8	16	2.5
Elongated Levallois Points								
Retouched	1	0.1	11	5.7	11	9.1	23	3.5
Unretouched	7	2.1	49	25.3	51	42.0	107	16.4
Flake Levallois Points								
Retouched	0	0.0	6	3.1	2	1.7	8	1.2
Unretouched	1	0.3	9	4.6	2	1.7	12	1.8
Retouched Blades	20	6.0	29	15.0	13	10.7	62	9.5
Retouched Bladelets	63	18.8	10	15.2	3	2.5	76	11.7
El-Wad Points	150	44.6	3	1.6	0	0.0	153	23.5
Other Retouched Pieces	40	12.0	37	19.0	19	15.7	96	20.3
Total Tools	**336**	**2.4**	**194**	**3.1**	**121**	**2.6**	**651**	**2.6**
TOTAL	**14114**	**56**	**6236**	**25**	**4732**	**19**	**25082**	**100**

a Includes flakes and ‘chips’ < 2 cm in greatest dimension.
b ‘Primary elements’ includes debitage from all categories except cores.

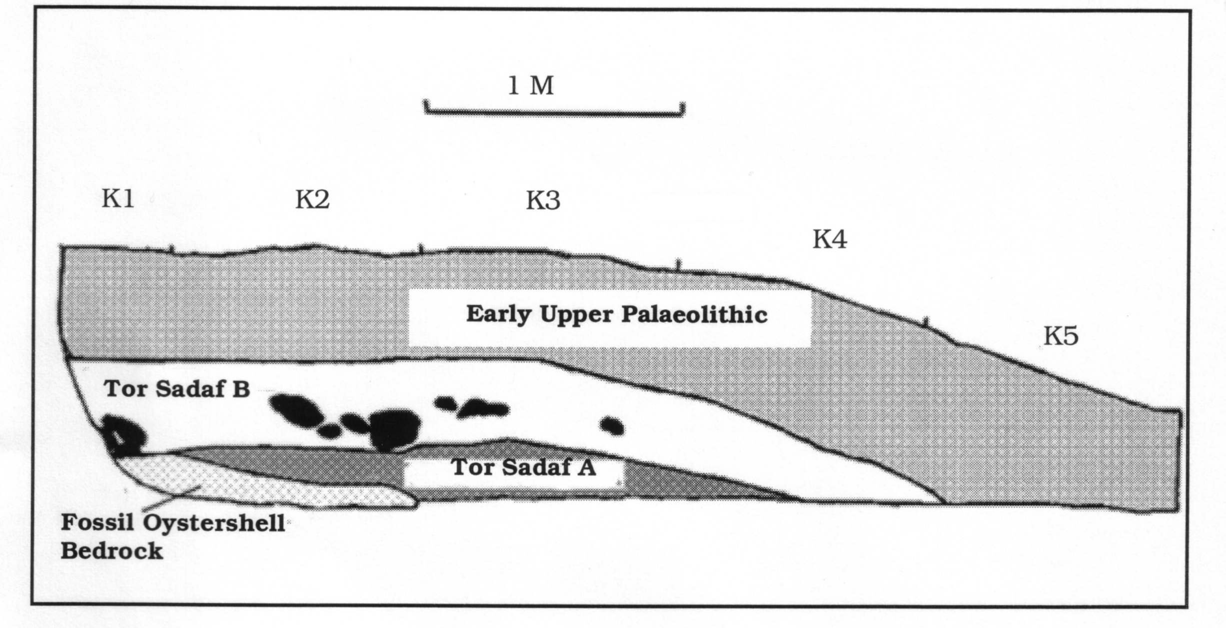

Fig. 8.5 Profile of the 'K' Trench at Tor Sadaf Showing Analytical Units (Occupational Levels) Discussed in the Text.

absence of radiocarbon dates, the assignment of this assemblage to the Early Upper Palaeolithic rests on two major factors. First, the assemblage appears broadly comparable technologically and typologically to Early Ahmarian assemblages in the Levant, including those from Boker A in the Central Negev (Jones *et al*. 1983), the Lagaman sites of the Sinai (Gilead and Bar-Yosef 1993), Ksar Akil in Lebanon (Bergman 1987a, 1988a) and southern Jordan (Coinman and Henry 1995; Williams 1997a; Kerry 1997a). The Early Upper Palaeolithic assemblage from Tor Sadaf also differs from the Late Ahmarian sites found in the Hasa area, such as Ain al-Buhayra and Yutil al-Hasa. These later sites have been dated to the interval of *ca*. 19–23,000 bp, and contain lithic assemblages with very small bladelets and retouched Ouchtata points (Coinman 2000). The Tor Sadaf Early Upper Palaeolithic materials also contrast with materials recovered from the recently discovered lakeshore site of Thalab al-Buhayra, dated to *ca*. 26,000 bp and only described preliminarily at this point (Coinman 2000:146–149).

Perhaps most importantly, the Tor Sadaf Early Upper Palaeolithic assemblage appears to be stratigraphically continuous with the earlier Tor Sadaf A and B assemblages, which appear to conform broadly with the technology seen at the transitional sites of Boker Tachtit and Ksar Akil (Marks 1983c; Marks and Kaufman 1983; Bergman 1987a; Ohnuma and Bergman 1990). Although a lack of radiometrically datable material from Tor Sadaf prevents definitively demonstrating the continuity between the Early Ahmarian and the earlier Tor Sadaf A and B, the stratigraphic and technological continuity at the site support this hypothesis.

In the Tor Sadaf A and B occupation levels, reduction appears primarily geared toward the production of large triangular points with blade-like proportions. I have categorized these points as 'Levallois,' on the basis of their morphological characteristics despite the fact that they often appear to have been produced by methods other than 'true' Levallois (discussion of this classification problem can be found in Marks 1983c and Volkman 1983). Following other workers in the Levant (*e.g.,* Marks and Kaufman 1983), I have included all Levallois points in the tool counts, whether retouched or not. Retouched blades also represent an important category of tools during these early occupations, suggesting that the production of blades may not have been purely incidental to the point production process. At Boker Tachtit, Volkman (1983) documented reduction strategies that produced both blades and Levallois-like points from a single reduction sequence. In general, Tor Sadaf A and B appear to document similar reduction strategies, and bear striking similarity to those assemblages described as 'transitional' or 'Initial Upper Palaeolithic' (Marks 1983c, 1993; Ohnuma and Bergman 1990). Below, each of the three occupation levels defined at the site is explored in terms of core and core trimming element samples, blade and bladelet debitage, and toolkits. Each of these categories of evidence is then summarized to elucidate changes in lithic core reduction strategies evidenced in the three assemblages.

Cores and Core Trimming Elements

Analyses of cores and core trimming elements provide an important line of evidence for changes in core reduction

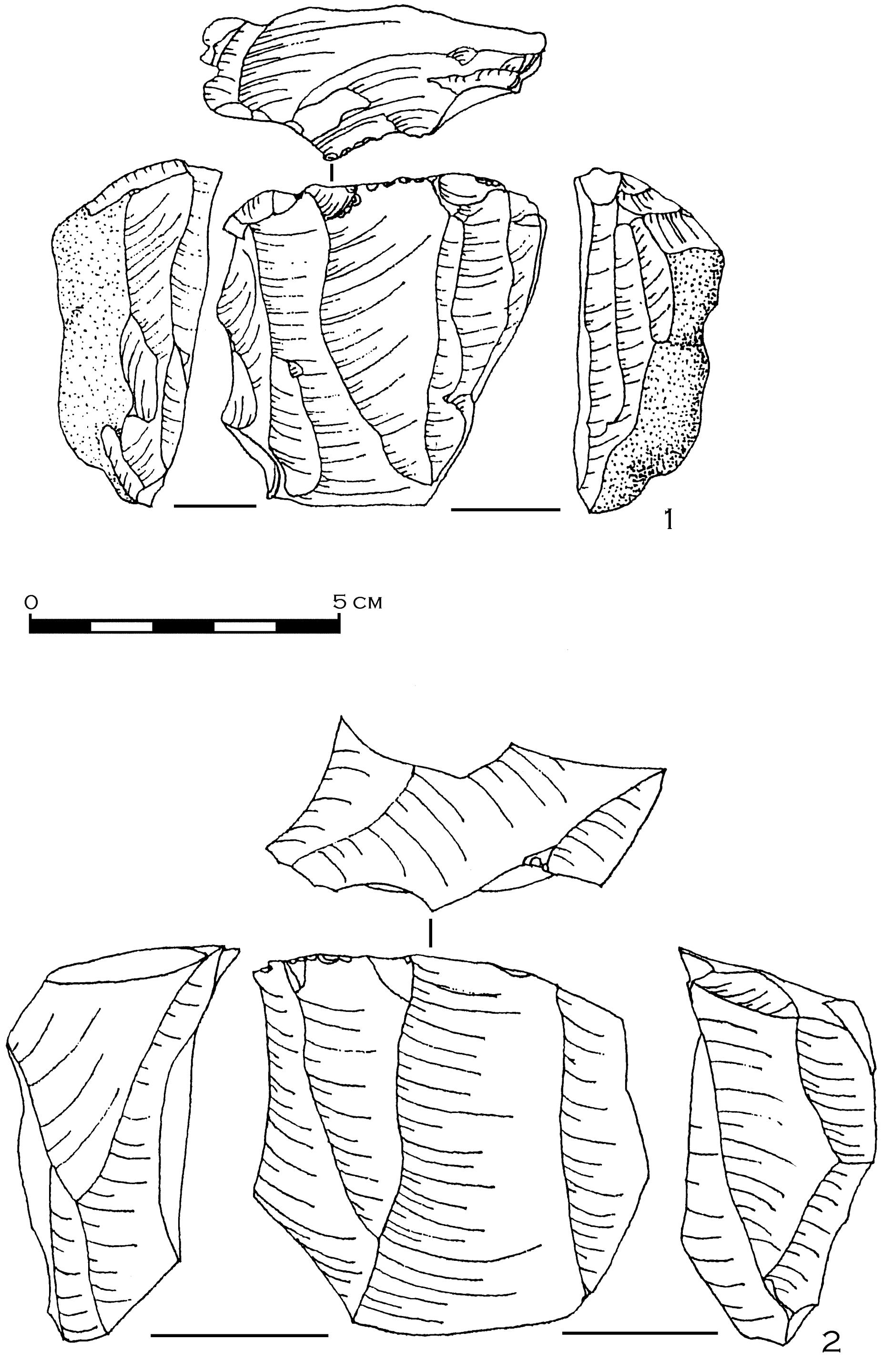

Fig. 8.6 Faceted Single Platform Elongated Point Cores from Tor Sadaf A (2) and B (1).

strategies. The great majority of cores from all three occupation levels are unidirectional, single platform types (Figs. 8.6–7). Cores that have more than one platform are in most cases those that have been reoriented; rarely is more than one platform involved in a single reduction sequence. There are, however, important changes in cores over time at the site. Cores from the Tor Sadaf A and B are predominately point cores, and are comparable to those seen at Boker Tachtit (Marks and Kaufman 1983). In the earliest levels (Tor Sadaf A), many of these cores show faceting as a means of platform preparation (Table 8.3). This characteristic fades over time, with a shift to simple, unfaceted platforms in the Tor Sadaf B levels. In both Tor Sadaf A and B, the type of platform faceting on

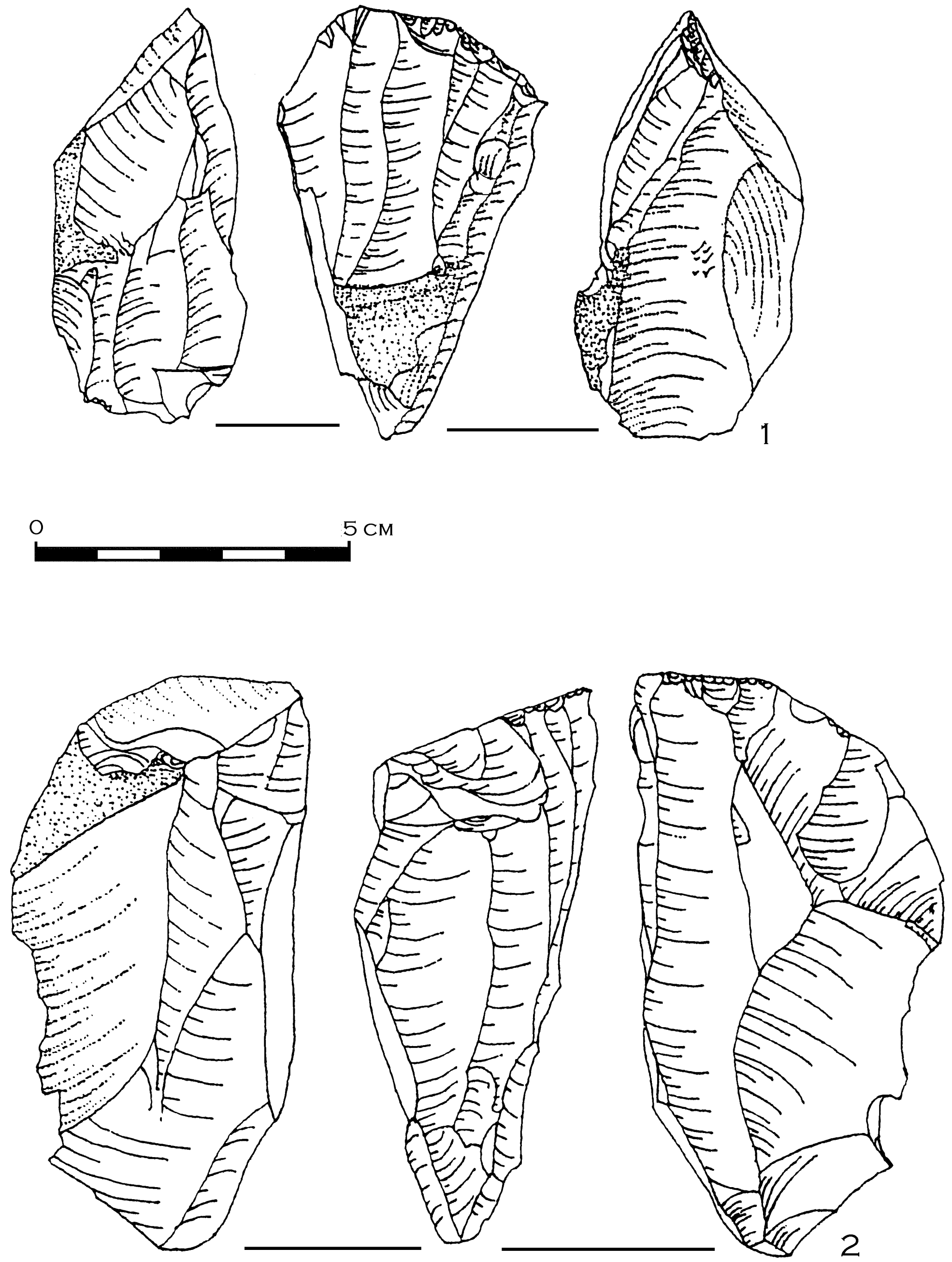

Fig. 8.7 Single Platform Blade/let Cores from the Tor Sadaf Early Upper Palaeolithic.

cores varies considerably. Faceting is at times of a fairly formal sort, producing convex platforms common in Levallois assemblages, but is often also of an apparently *ad hoc* informal sort. Nearly all the Early Upper Palaeolithic cores have unfaceted platforms, as expected in an assemblage dominated by a true blade technology. This shift to unfaceted platforms is correlated with other changes in reduction strategies discussed below.

Core trimming elements represent 0.7–1.0% of the debitage from each of the three occupation periods. These pieces are sorted into three general types, and illustrate shifts in core reduction strategy over time (Fig. 8.8). The use of crested and unifacial platform blades becomes more common over time at Tor Sadaf, culminating in the blade technology of the Early Upper Palaeolithic. The use of the core tablet technique, though present in all three occupation levels, is quite rare in the Tor Sadaf A assemblage, becoming more prominent in the subsequent Tor Sadaf B and the dominant type of core trimming element in the Early Upper Palaeolithic.

Table 8.3 Frequencies and Percentages of Cores with Unfaceted, Dihedral and Muti-Faceted Platforms by Occupation Level from Tor Sadaf.

	Unfaceted		Dihedral		Multi-Faceted		Other	
Cores	n	%	n	%	n	%	n	%
Early UP	68	78.2	9	10.3	6	6.9	4	4.6
Tor Sadaf B	29	53.7	7	13.0	13	24.1	5	9.3
Tor Sadaf A	22	40.0	8	14.5	25	45.5	0	0.0
Total	**119**	**60.7**	**24**	**12.2**	**44**	**22.4**	**9**	**4.6**

Table 8.4 Metric Attributes of Complete Blade/lets by Occupation Level from Tor Sadaf.

Occupation Level	Length (mm)	Width (mm)	Thickness (mm)	Length: Width Ratio	Width: Thickness Ratio
Early UP (n=435)					
mean	46.19*	12.21*	3.84*	4.10*	3.44*
sd	16.20	5.78	2.06	1.21	0.96
Tor Sadaf B (n=164)					
mean	57.94	20.53	7.11	2.99	3.16
sd	19.16	7.34	3.11	0.89	0.84
Tor Sadaf A (n=160)					
mean	58.20	20.60	7.30	2.99	3.18
sd	18.56	7.44	3.11	0.84	0.96
*ANOVA indicates statistical significance ($p < .05$)					

Overpassed pieces represent a third important category of core trimming element, and show continuous decline across the three occupation levels. Most of these pieces have blade proportions, and typically originate on an unfaceted platform. These overpassed core trimming elements remove portions of the distal end of the core, generating a pyramidal core shape. Occasionally, these pieces originate from the distal end of the core, but accomplish a similar result. Overpassed core trimming elements that originate on the distal end of the core typically remove significant portions of both the distal and proximal ends of the core as well as most of the core face. At Tor Sadaf, many of these overpassed pieces preserve aspects of the lateral portions of core faces, suggesting that these core trimming elements may have simultaneously served to reshape the lateral aspects of the core. Reshaping of lateral core faces is a necassary feature of unipolar, convergent reduction strategies that produce large numbers of Levallois-type products (Hovers 1998:149–150).

Blade and Bladelet Debitage

Table 8.2 shows that while blade production was important in all three occupation levels at Tor Sadaf, production shifted toward smaller blank forms during the Early Upper Palaeolithic. Metric data from blades and bladelets are shown in Table 8.4, where it can be seen that the Early Upper Palaeolithic assemblage appears distinct from the earlier assemblages in every attribute, and these differences are highly significant statistically. In overall shape, blade debitage from the Tor Sadaf A and B periods appear very similar, and ANOVA tests suggest no significant differences. These results contrast with those seen for platform metrics in Table 8.5, where all three assemblages show distinct differences, which are highly significant statistically. These results illustrate that, although there is a shift in reduction strategy and platform preparation, blank production is remarkably stable in terms of overall metrics from the Tor Sadaf A to B assemblages. The Early Upper Palaeolithic assemblage stands separate from the earlier ones both in terms of overall blank and platform metrics.

Differences in the metric attributes of blades and bladelets in the three assemblages are also correlated with a number of distinct platform attributes (Fig. 8.9). In this analysis, punctiform platforms were defined as small (less than 5 mm in largest dimension) linear platforms, with abraded dorsal aspects, which contrast strongly with the large, unfaceted platforms common on many blades. The Tor Sadaf A assemblage is associated with a balance of large, faceted and unfaceted platforms. The Tor Sadaf B is associated almost entirely with large unfaceted platforms, and gives way to the Early Upper Palaeolithic assemblage, where the overwhelming majority of blades and bladelets have extremely small, punctiform platforms.

A final set of platform attributes can be used to understand shifts in blade production over time (Table

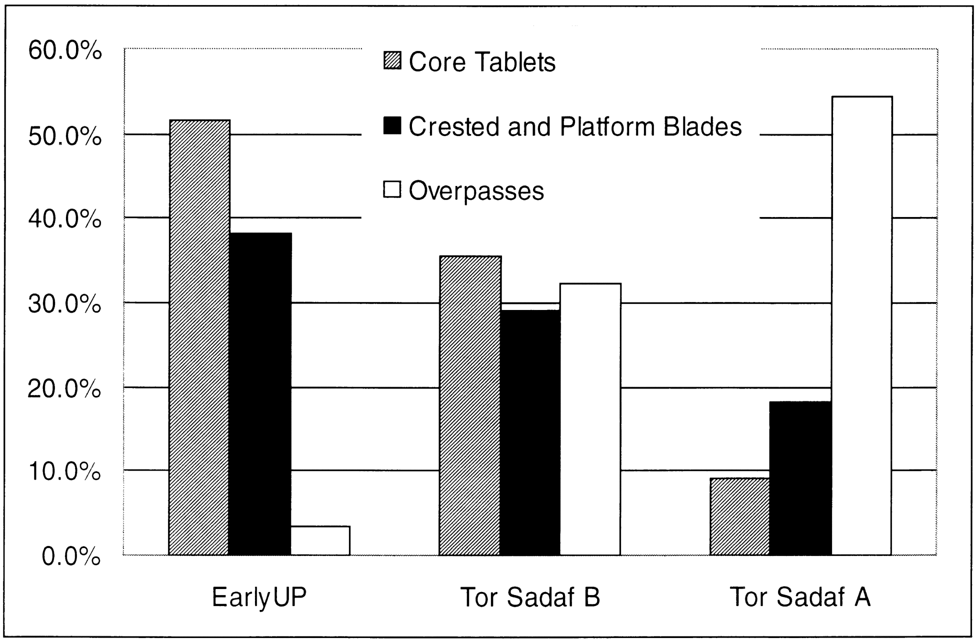

Fig. 8.8 Percentages of CTE by Occupation Level at Tor Sadaf.

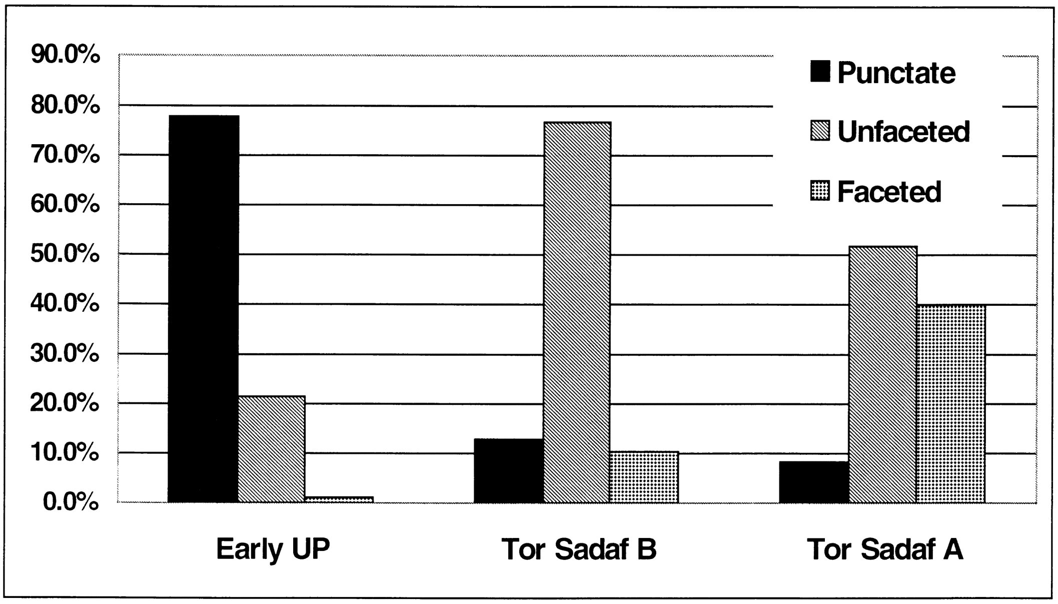

Fig. 8.9 Percentages of Blade/lets with Punctate Unfaceted and Faceted Platforms by Occupation Level at Tor Sadaf.

8.6). Although it is known that platform lipping, *éraillure* scarring and prominent percussion bulbs can be produced using any mode of flaking, the frequency of these attributes in large numbers of artefacts is strongly suggestive of hard hammer *versus* soft hammer and indirect percussion modes. The increased frequency over time of diffused bulbs of percussion and lipped platforms combined with the decreased frequency of *éraillure* scars suggests a long-term shift in blade production techniques from direct hard hammer percussion to soft hammer and indirect percussion modes of flaking. Chi-square tests indicate that differences in the frequencies of these attributes are highly significant between the three occupation levels. This trend is consistent with the notion of the emergence of true blade technology commonly associated with the Upper Palaeolithic.

Table 8.5 Metric Attributes of Blade/let Platforms by Occupation Level from Tor Sadaf.

Occupation Level	Platform Width (mm) (lateral – lateral)	Platform Thickness (mm) (dorsal – ventral)	Platform Size (WidthxThickness) (mm)
EUP (n=709)			
mean	3.63*	1.54*	9.64*
sd	3.29	1.39	26.80
Tor Sadaf B (n=284)			
mean	11.86*	5.25*	83.26*
sd	7.39	3.45	77.10
Tor Sadaf A (n=225)			
mean	13.76*	5.83*	98.30*
sd	7.15	3.33	85.18
*ANOVA indicates statistical significance (p < .05)			

Table 8.6 Frequencies and Percentages of Blade/lets with Platform Characteristics by Occupation Level at Tor Sadaf with Chi-Square Test Statistics.

Platform Characteristics	Early UP		Tor Sadaf B		Tor Sadaf A		Chi-Square	Sig.
Bulb of Percussion	n	%	n	%	n	%		
Prominent	34	5.0	106	55.8	108	69.2		
Diffuse	641	93.7	80	42.1	43	27.6		
Broken	9	1.3	4	2.1	5	3.2	425.2	<.0005
Platform Lipping								
Present	526	76.9	59	31.1	43	27.6		
Absent	158	23.1	131	68.9	113	72.4	217.6	<.0005
***Éraillure* Scars**								
Present	30	4.4	45	23.7	32	20.5		
Absent	654	95.6	145	76.3	124	79.5	79.7	<.0005

Tools

The tool assemblages from Tor Sadaf are dominated by point forms throughout all three levels. Burins increase in frequency slightly over time, but in general, remain quite unimportant in all three occupation levels. End-scrapers, in contrast, are a consistently important tool form throughout the three periods. Retouched blades are more abundant in Tor Sadaf B than in the earlier Tor Sadaf A, but are replaced almost entirely by retouched bladelets during the Early Upper Palaeolithic. The most abundant tool forms by far in all three assemblages are points, especially those on blanks of blade/bladelet proportions. With the exception of the elongated Levallois points, all three toolkits appear typologically Upper Palaeolithic in character. Sidescrapers, notches and denticulates are all rare throughout the sequence.

For the Tor Sadaf A and B assemblages, points are mostly of the elongated Levallois type (Fig. 8.10), and appear similar to those documented in other transitional contexts (Marks and Kaufman 1983) and some Middle Palaeolithic contexts as well, particularly those of Tabun D type (*e.g.*, Lindly and Clark 1987). In this analysis, these points were defined as triangular pieces with converging lateral margins, and included both retouched and unretouched pieces. Dorsal scar patterns suggest that nearly all of these points were produced on unidirectional, single platform cores (Fox 2000). Metric attributes of the Levallois points show that in overall metrics, those from the Tor Sadaf A and B assemblages are virtually indistinguishable (Table 8.7) and generally are remarkably similar in size to the blade debitage discussed earlier for Tor Sadaf A and B (Table 8.4).

The abundance of el-Wad points in the Early Upper Palaeolithic assemblage is an important indicator of the well-known Early Ahmarian entity in the Levant. At Tor Sadaf, these points are typically produced on relatively large bladelets and small blades, and are commonly characterized by right proximal obverse and inverse retouch, and distal right and left obverse retouch (Fig. 8.11). These points are in fact highly variable in retouch attributes, but appear relatively distinct in metric attributes, as shown by the very small standard deviations in Table 8.8. At Tor Sadaf, el-Wad points are invariably associated with punctiform platforms, showing lipping, diffuse bulbs of percussion and abraded platform edges.

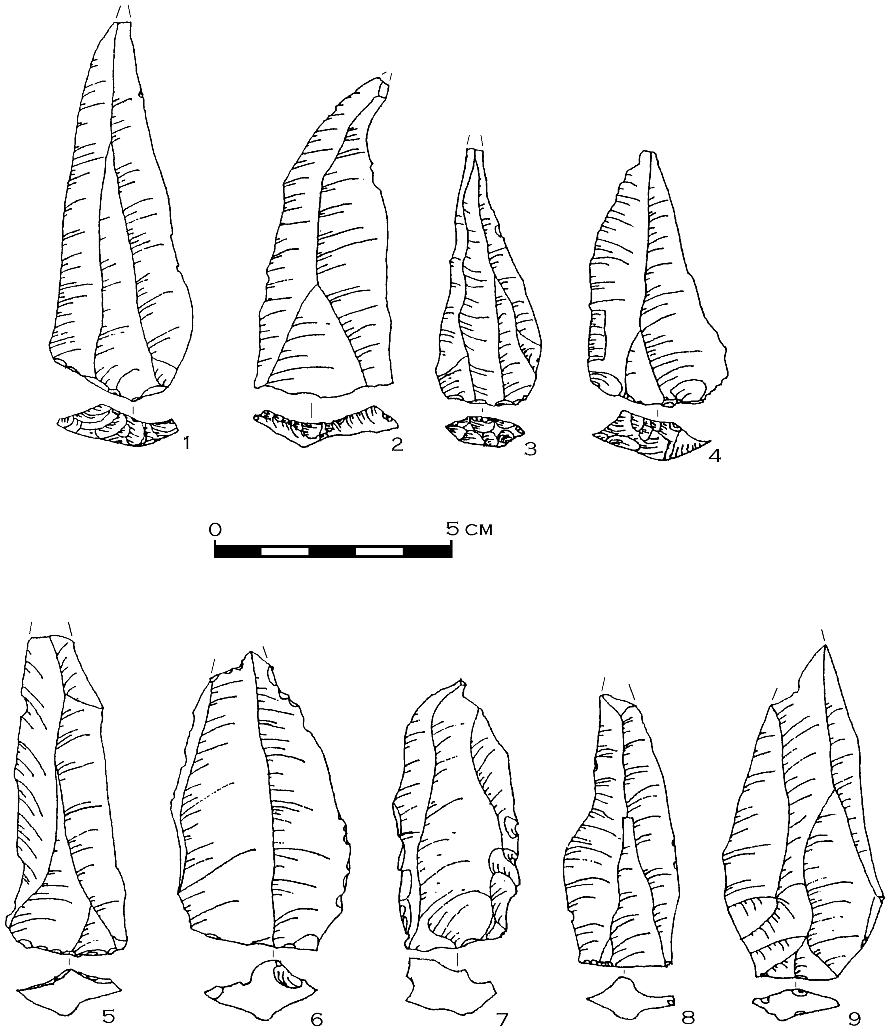

Fig. 8.10 Elongated Levallois Points from Tor Sadaf: a-d, Points with Faceted Platforms from Tor Sadaf A; e-i, Points with Unfaceted Platforms from Tor Sadaf B.

Lithic Technology and Core Reduction Strategies at Tor Sadaf

The analysis presented here illustrates a sequence of changing core reduction strategies at Tor Sadaf. The earliest occupation level at the site, represented by the Tor Sadaf A assemblage, is characterized by a single-platform core reduction strategy focused on the production of elongated Levallois-like points using a reduction strategy not typically Levallois in nature. Blanks were struck from cores with roughly equal proportions of either faceted or unfaceted platforms using hard hammer percussion. These point cores were shaped and maintained by the removal of unifacial platform blades and large, overpassed pieces. The latter were used to trim the distal aspects of cores (generating a pyrammidal shape). Although the core tablet technique is evident, it appears to have been applied relatively rarely. Instead, platforms were commonly shaped and maintained through removal of small flakes, creating many faceted platforms on cores, debitage and points. The reduction process also produced a significant number of blades, many of which were re-touched and represent a substantial portion of the toolkit in the assemblage.

The Tor Sadaf B assemblage is typologically indiscernible from, and technologically similar to, the Tor Sadaf A assemblage. But some important technological differences should be noted. Cores continue to be oriented unidirectionally, and large elongated points continue to be a major objective of reduction. Use of overpassed pieces as a means of shaping cores continues to be important, but core preparation and maintenance appear to be more variable than before. The use of unfaceted platforms predominates, and evidence of this change is preserved in platforms of cores, blades and points. In Tor

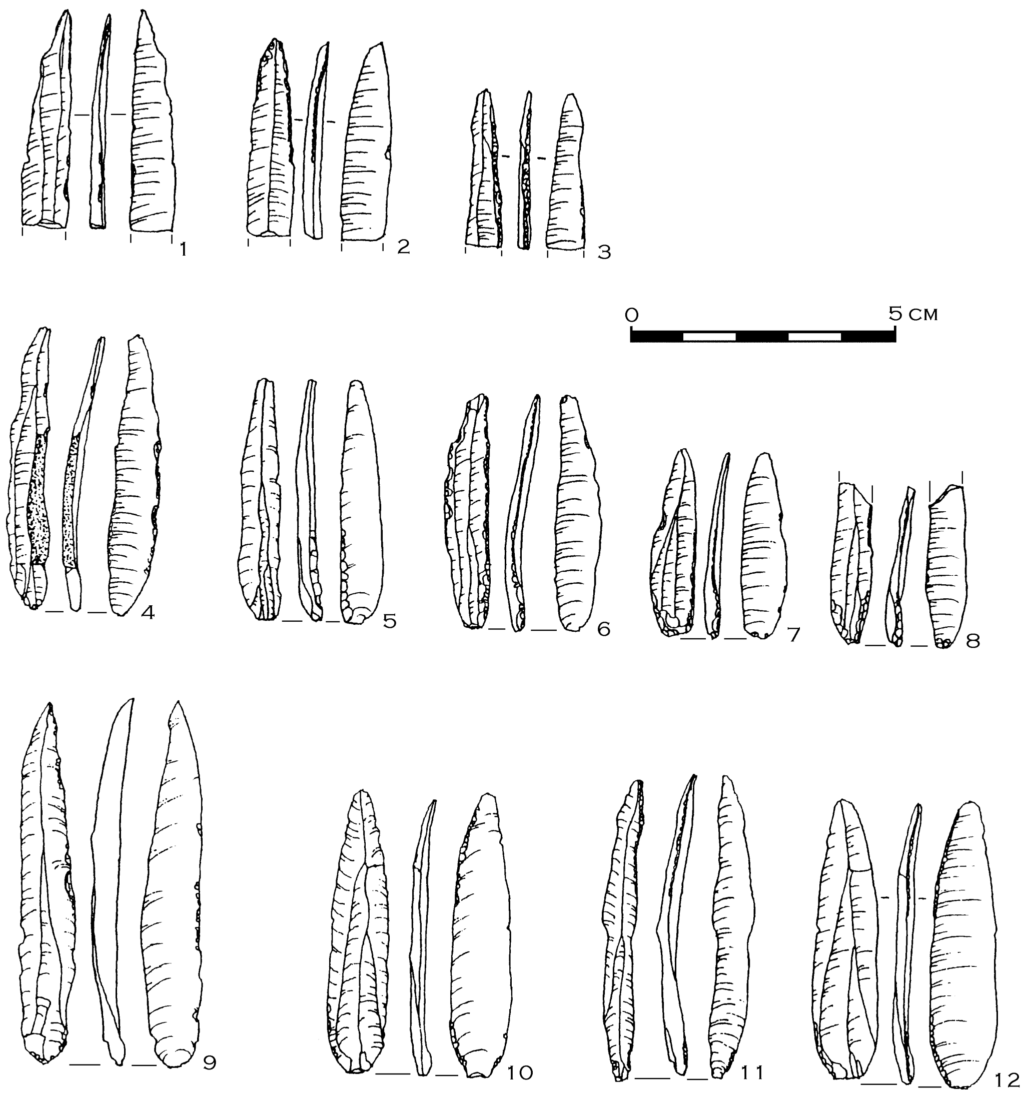

Fig. 8.11 El-Wad Points from the Early Upper Palaeolithic Tor Sadaf Assemblage.

Sadaf B the core tablet technique appears to be an important means of maintaining platform regularity and angle, replacing the platform faceting seen earlier in the Tor Sadaf A assemblage. Hard hammer percussion continues to be the dominant mode of flaking, though platform attributes suggest an increasing frequency of soft hammer and indirect flaking modes. Given these technological differences between the Tor Sadaf A and B assemblages, it is striking that the debitage and tools from the two assemblages should appear so uniform in metric and typological attributes. This is a clear example of a shift in technology that is not reflected in tool or debitage typology. This decoupling of lithic technology and typology in assemblages of a transitional nature was noted by Marks (1983c).

The Early Upper Palaeolithic assemblage from Tor Sadaf is characterized by both a technological and a typological shift from the previous levels. The assemblage shows a marked increase in blade and bladelet production, which is related to the emergence of a true blade technology, where uniform series of blades and bladelets are removed from core faces using soft hammer and indirect percussion. Cores continue to be overwhelmingly unidirectional and single platform. The growing number (compared to previous occupation levels) of bifacial crested blades and the predominance of the core tablet technique are also strong indicators of a truly Upper Palaeolithic blade technology appearing at this time. Typically Early Ahmarian artefacts, especially retouched blades and bladelets and el-Wad points, dominate the toolkit.

The Early Upper Palaeolithic assemblage from Tor Sadaf exhibits the most diagnostic traits of the three assemblages, and can be clearly added to the large number of Ahmarian manifestations known throughout the Levant. First defined in the 1980s (Gilead 1981a; Marks 1981b),

Table 8.7 Metric Attributes of Levallois-like Points from the Tor Sadaf Transitional A and B Assemblages.

Occupation Level	Length (mm)	Width (mm)	Thickness (mm)	L:W Ratio	W:Th Ratio
Tor Sadaf B (n=54)					
mean	59.08	22.28	7.32	2.71	3.20
sd	15.98	5.07	2.36	0.70	0.76
Tor Sadaf A (n=48)					
mean	57.84	22.88	7.28	2.66	3.25
sd	14.13	6.22	2.31	0.76	0.66

Table 8.8 Metric Attributes of el-Wad Points from the Tor Sadaf Early UP Assemblage.

El-Wad Points	Length (mm)	Width (mm)	Thickness (mm)	L:W Ratio	W:Th Ratio
n	20	152	152	20	152
mean	43.63	7.02	2.22	5.50	3.26
sd	9.69	1.51	0.54	1.08	0.73

the Ahmarian is increasingly being differentiated into early and late phases (Bergman and Goring-Morris 1987; Coinman 1997b; Ferring 1988; Williams 1997a), with el-Wad points typically associated with the early part of the sequence. The Tor Sadaf Early Upper Palaeolithic assemblage fits nicely into the Early Ahmarian classification, given its high proportions of el-Wad points, unidirectional core reduction strategy, use of a true blade technology and the fact that it overlies an assemblage clearly associated with an earlier technological phase. This classification would be strengthened considerably by radiocarbon dating of the Early Upper Palaeolithic materials, but in the absence of datable remains only technological analyses are available. If it is accepted, as I have argued here, that the Early Upper Palaeolithic assemblage from the site represents the Early Ahmarian and that the Early Upper Palaeolithic assemblage appears stratigraphically continuous with the Tor Sadaf A and B occupation levels, then the date from the site of Boker A (Jones *et al*. 1983) would suggest that the Early Upper Palaeolithic at Tor Sadaf might begin as early as 37–38,000 bp.

Classification of the Tor Sadaf A and B assemblages and placing them into the broader chronological context of the Levant is somewhat more problematic. Transitional assemblages are only known from a small handful of contexts in the Levant, providing a limited knowledge of the variability associated with the Middle to Upper Palaeolithic transition. The Tor Sadaf A and B assemblages appear to most closely resemble assemblages in the Levant classified as either transitional between the Middle and Upper Palaeolithic (Azoury 1986) or initial Upper Palaeolithic (Marks and Ferring 1988, Kuhn *et al*. 1999). All such assemblages also resemble, at least in some superficial sense, the Middle Palaeolithic entity known as Tabun D (Jelinek 1981a, b). Tabun D-type assemblages have been associated with dates from the very early parts of the Levantine Mousterian, however, so these assemblages are not helpful in estimating the age of transitional assemblages such as those from Tor Sadaf. In short, only the site of Boker Tachtit offers any guidance in indicating the approximate timing of the Tor Sadaf A and B occupation levels. If it is accepted that the Tor Sadaf A and B represent a technological bridge between the Boker Tachtit level 4 assemblage and the subsequent Early Ahmarian (as seen at Boker A and in the Tor Sadaf Early Upper Palaeolithic assemblage), then an estimate of between perhaps 43–38,000 bp can be tentatively suggested.

In this paper, I have generally regarded the Tor Sadaf A and B assemblages as 'transitional' between the Middle and Upper Palaeolithic. I have used this term in favor of other designations that are available, for example 'Emiran' (Bar-Yosef 1998a) or initial Upper Palaeolithic (Marks and Ferring 1988). Recently, it has been suggested that the use of the term 'transitional' may be misguided, since it implies a 'direct phylogenetic relationship' between lithic industries of the Middle and Upper Palaeolithic (Kuhn *et al*. 1999). It would be beyond the scope of this paper to explore the implications of various means of classifying these assemblages. For the purposes of the above discussion, I have sought to demonstrate that the Tor Sadaf A and B assemblages appear to be truly transitional in at least one sense; they represent a technological bridge between an earlier phase similar to that documented by Marks (1983c) at Boker Tachtit, and the subsequent Early Ahmarian found throughout the Levant. In this way, the evidence from Tor Sadaf appears to support the proposition put forth by Marks (1983c) nearly twenty years ago, that the Early Upper Palaeolithic (specifically the Early Ahmarian as seen at Boker A) is a

direct development of earlier lithic industries seen at Boker Tachtit, Ksar Akil and now, at Tor Sadaf.

Conclusions

The lithic assemblages from Tor Sadaf provide an important new database for understanding the Middle to Upper Palaeolithic transition and the earliest Upper Palaeolithic in the Levant. The assemblages document a clear shift in lithic technology, beginning with a single platform technology focused on the production of numerous elongated Levallois points, to one increasingly dominated by a true blade technology. In the absence of radiometric dates from the site, it is difficult to say with certainty how the Tor Sadaf A and B assemblages fit into the regional chronology of the Levant. It seems clear that these assemblages are related to so-called 'transitional' and 'Initial Upper Palaeolithic' assemblages from other sites in Israel and Lebanon (Marks 1983c; Ohnuma and Bergman 1990). Future research, and especially radiocarbon dates, should provide the ability to further evaluate the propositions put forth here. First, absolute dates would solidify the argument made here, that the vertical sequence at the site represents a technological continuum from a transitional assemblage to a true Upper Palaeolithic one. Second, datable materials would resolve the question of whether the transitional materials from the Tor Sadaf A and B assemblages represent occupations contemporaneous with those from Boker Tachtit (suggesting regional variability), or if they in fact date to a later phase intermediate between the Boker Tachtit level 4 assemblage and the subsequent Early Ahmarian. Should, however, such datable materials not be forthcoming, interpretation of the Tor Sadaf materials and their implications for the Levant in general must rely on further technological and palaeoenvironmental data.

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Notes

1 The phytolith analyses were conducted by Arlene Miller Rosen, Institute of Archaeology, University College of London.

2 In a previous preliminary report (Coinman and Fox 2000), Tor Sadaf A and B were referred to as Transitional A and B.

9. Variability and Change in the Early Upper Palaeolithic of the Levant

James L. Phillips and Iman N. Saca

Introduction

Understanding variability in the Upper Palaeolithic of the Levant has been riven with misconceptions. These involve the degree to which variability in the archaeological record effects our conception of a lithic tradition, how these traditions are defined and explicated, and what they mean. First and foremost, we should understand that the variability in lithic assemblages is caused by multiple factors, including site function, settlement pattern, corporate tradition, stylistic and idiosyncratic behaviour, environment and terrain, chronology, *etc*.

One way out of this conundrum is to view lithic variability from both a stylistic and functional perspective, statically and dynamically. This implies using the *chaîne opératoire* approach (Becker 1999; Pelegrin 1990; Pelegrin *et al*. 1988; Phillips 1991), thus reviewing decision-making processes of hunting-gathering groups and individuals as they manufacture, use, and abandon implements in their yearly or seasonal movements over a variety of landscapes and subsistence territories (Ingold *et al.* 1989). Further, we should reasonably expect that the same archaeological tradition may well be regionally variable, even when the environment, terrain, and subsistence patterns are similar. Distance from one another, with aggregation of populations occurring sporadically and not annually, leads to social isolation and thus the trend toward 'cultural' disconnection and developmental differentiation.

History of Research

There have been several studies dealing with lithic variability in the Upper Palaeolithic of the Levant. Most of these analyses focused on either the technology or typology of the assemblages, generally ignoring other variables (see Gilead 1981a; Phillips 1987a; Ferring 1988; Coinman and Henry 1995). This paper will deal with lithic variability as well as other variables, such as adaptations to specific ecological and environmental locations, which may have caused or directed the lithic variability seen in the archaeological record. With this caveat in mind, we can turn to the early Upper Palaeolithic of the Levant and attempt to extract features of the traditional viewpoints with which we agree, and then endeavour to provide a different approach to the problem of understanding lithic and settlement variability in the Levantine Upper Palaeolithic.

Two traditions partially coexisted in the Levantine Upper Palaeolithic (Fig. 9.1). One, termed by Gilead (1981a, 1989, 1991) the Ahmarian, appears to have developed locally in the central (south of Beirut, north of Beersheva) and southern Levant (Beersheva south to the tip of Sinai), possibly emerging out of a very advanced Late Mousterian in the more arid areas of the Judean Hills, the Negev and Sinai. Evidence at the site of Boker Tachtit in the Negev, (Marks 1983a, c; Marks and Ferring 1988) as well as at Ksar 'Akil in Lebanon (Bergman 1988a), in the Galilee (Emireh) (Garrod 1951, 1955)and the Judean desert (et-Tabban and, perhaps Erq el-Ahmar) (Neuville 1934, 1951; see also Bar-Yosef 1998a, 2000) suggests that Upper Palaeolithic tool types were a dominant theme by approximately 45,000 bp (Bar-Yosef *et al*. 1996; Marks 1983a; Phillips 1994). By 40–38,000 bp at the nearby site of Boker A (Jones *et al*. 1983) and in mountainous southern Sinai at the Abu Noshra sites (Phillips 1987a, 1988, 1994, in press; Gladfelter 1997), a fully developed technologically and typologically Ahmarian tradition was the dominant archaeological culture of the region(s).

The analysis of Upper Palaeolithic assemblages, and their subsequent partition into lithic traditions was first proposed by Dorothy Garrod and René Neuville (Garrod and Bate 1937; Garrod 1957; Neuville 1934, 1951). Excavating independently in the southern Levant from 1928 until World War II, they each recognized that in the Galilee and the Judean Desert some cave sites contained different types of Upper Palaeolithic assemblages, often, as in the case of el-Wad (Garrod and Bate *ibid.*), Kebara (Turville-Petre 1932), and Erq el-Ahmar (Neuville 1951), stratified one above the other. As Belfer-Cohen and Bar-Yosef (1999:119) have noted '… they both came up with a detailed scheme of the various prehistoric entities, their

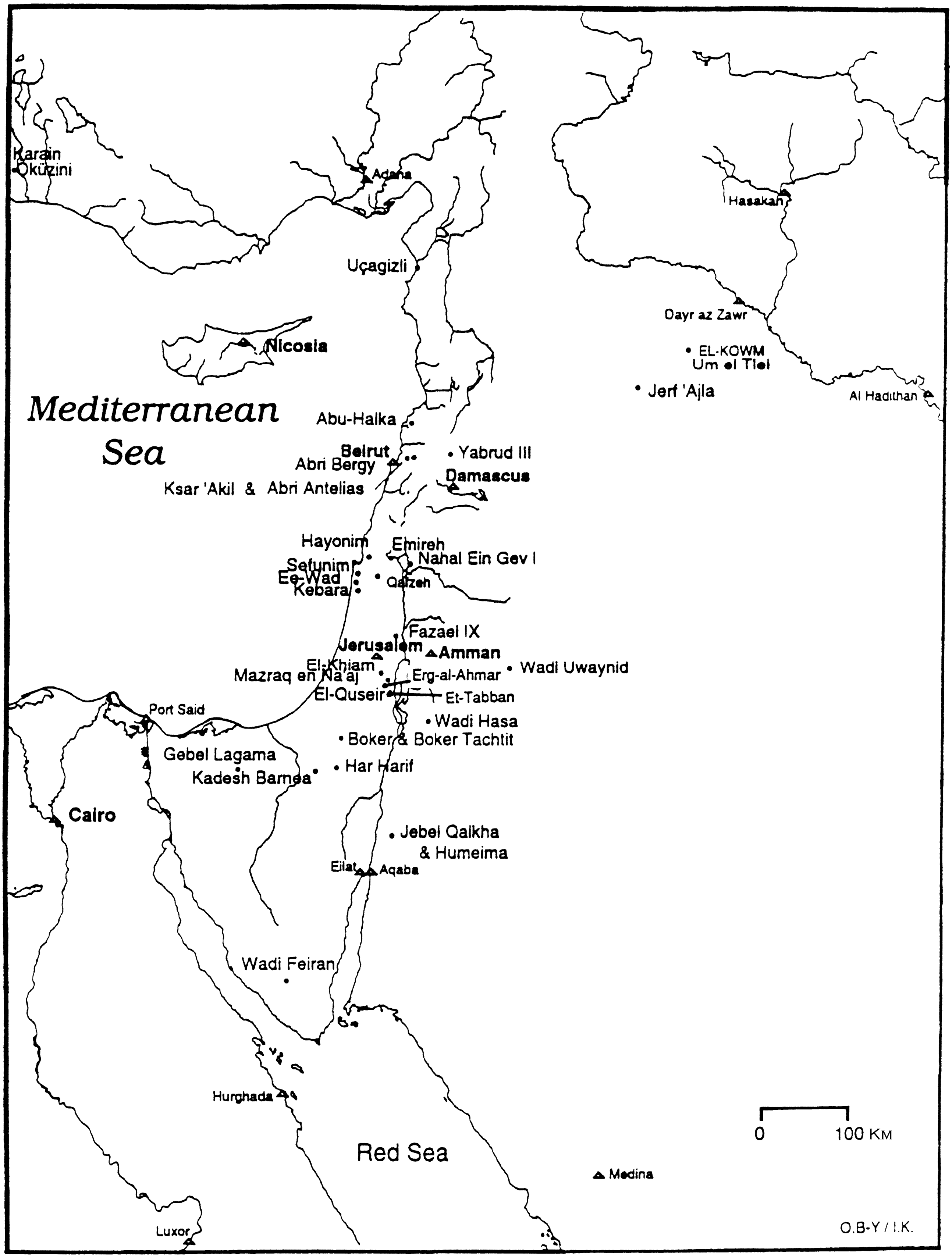


Fig. 9.1 Upper Palaeolithic sites in the Levant.

main characteristics, the sites and layers from which they were recovered, and their place in the chronological sequence of the Upper Palaeolithic. *This basic framework remains to this very day*' [emphasis added].

In their recent review of the history of investigation of the Levantine Aurignacian, Belfer-Cohen and Bar-Yosef (1999:120, Table 10.1), present Neuville and Garrod's sequence for the Upper Palaeolithic, with modifications after Copeland (1975). It is clear that the sequence was divided into units based on different typological markers, as well as sequences from stratified caves, such as el-Wad, Qafzeh, Erq el-Ahmar, Kebara, and el-Khiam. Neuville and Garrod did not consider the settlement patterns, landscape or site locale as an integral part of their interpretation. Additionally, the original excavators did not probe these particular caves with modern techniques; therefore the lithic assemblages recovered from these caves are missing significant elements.

More recent excavations at some of these caves (Kebara, Qafzeh, Erq el-Ahmar, Ksar Akil) indicate that, although the basic stratigraphic sequences constructed by Garrod and Neuville remain intact, microstratigraphic, microfaunal and microbotanical evidence suggest that refinement of the sequences is necessary (see Goldberg 1995; Goldberg and Bar-Yosef 1998; Tsatskin, *et al*. 1995; Weiner *et al.* 1993). Archaeological information from these caves needs also to be reviewed, as more modern excavations have yielded the micro-debitage and microfaunal portions of the assemblages, and three dimensional piece plotting has yielded spatial and activity data unknown from the previous excavations.

However, one of the major drawbacks of the use of assemblages from these caves, or from any cave for that matter, is that entire surfaces cannot be excavated and therefore activity or spatial anomalies on a given floor or surface are not often recognized. This leads to a rather skewed view of the behaviour of human populations in rockshelters or caves, and a trend toward explanations based upon techno-typological schemes, rather than models of behaviour based on the recognition of spatial and activity analyses.

The Nature of Variability

Typological variability of assemblages among sites of hunter-gatherers of the same lithic tradition is viewed, by some, as being representative of different corporate groups (Clarke 1978; Bettinger 1991; Kelly 1995). However, even though the technology and mode of production of the assemblages remain similar within a tradition, regional variation in typologies may not necessarily be the signature of different groups. The variation may be explained by other factors, including adaptations to local landscapes and environments, resource procurement systems, the functional role of particular artefacts in an assemblage, or a hunter-gatherer sharing strategy that, for example, may require particular weapons within a group to be identifiable (see Wiessner 1983). Consequently, while regional or even local differences in lithic typologies commonly are recognized among hunter-gatherers, they cannot be properly understood unless the activities within a site are adequately documented, and the functional relationship of a site to the subsistence system to which it belongs is properly established. A realization of these objectives requires that the prehistoric landscape of the hunting and gathering activities and the habitat and environment of the archaeological sites be reconstructed.

All excavated early rockshelter and cave assemblages were found within thick deposits, which were (often) disturbed by post-occupational agencies. This prevented the study of intra-site variability, since floors were not defined, and vertical and horizontal displacement by taphonomic agencies is a major problem. Thus, caves and rockshelters can provide real information concerning changes in lithic production through time, but it is a very rare case where these excavations can tell us much about intra-site patterning (see Rigaud and Géneste1988). Open-air sites, on the other hand, the majority of which are found in the southern Levantine arid or semi-arid zones, do allow the investigator, given proper excavation techniques and laboratory procedures, to reconstruct intra-site activities and begin to model behaviour in quite different ways than from cave or rockshelter sites (Phillips 1991; Becker 1999, herein; Keeley 1991; Nadel 1996, herein).

Variability within the Upper Palaeolithic traditions may be affected by other factors, including site size, and the particular settings of the occupations in prehistoric landscapes. In attempting to understand such variations, it is important to recognize the discordance between the natures of the archaeological and environmental records. A prehistoric occupation at an archaeological site is a fleeting occurrence (perhaps even with precise temporal definition) at some time within the macro, spatio-temporal contexts of 'climate' and landscape. The palaeoenvironment that we wish to identify was a dynamic system that encompassed geological, climatological and biological subsystems, including the archaeological activity at a site. But the activity at the site, although part of a cultural system we try to understand, is notwithstanding a brief moment within the temporal context of the palaeoenvironmental systems.

The consideration of palaeo micro-environmental variability should allow us an understanding of the settlement systems based on a reconstruction of subsistence strategies (Gladfelter 1997, 2000). Macrobotanical remains are scarce in Levantine Upper Palaeolithic sites. This is often due to their poor preservation, but also because flotation was not attempted during the late 20's and 30's, and wet and dry sieving was often not used. Thus, nearly nothing is known about Upper Palaeolithic hunter-gatherer vegetal diets, except from the terminal Upper Palaeolithic/Early Epipalaeo-

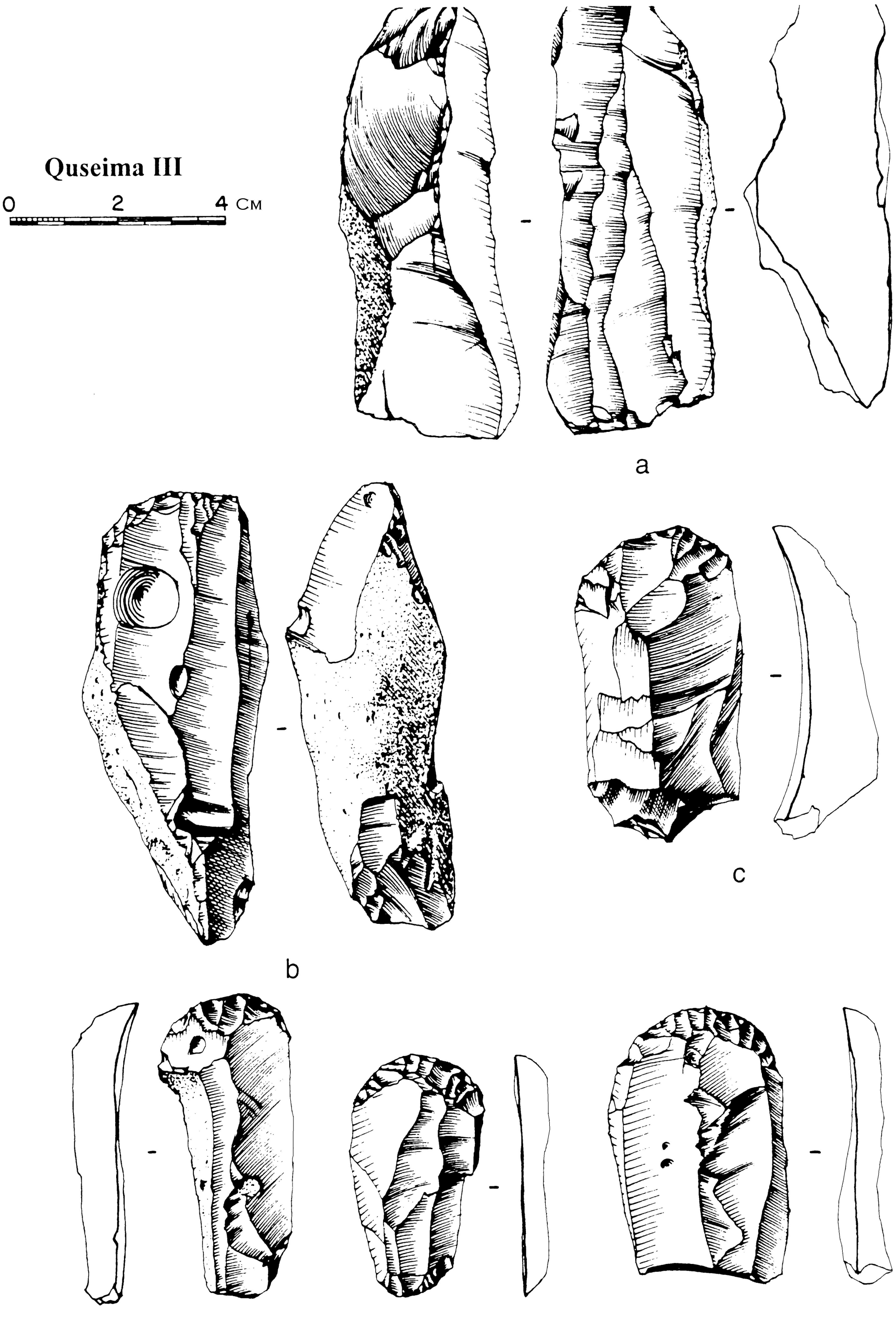


Fig. 9.2 Quseima III: a-b Cores; c-e Endscrapers.

lithic site of Ohalo II on the southwestern shore of the modern Sea of Galilee (Nadel *et al.* 1994; Nadel herein). Understanding the subsistence strategies of these hunter-gatherers will shed light on why there is variability in the deposition of the Upper Palaeolithic assemblages.

Upper Palaeolithic Subsistence Systems

Perhaps as a consequence of inadequate analysis of environmental regimes, present day reconstructions of settlement patterns, based on a variety of data, are not all in mutual agreement. The picture is spatially fragmented, poorly controlled temporally, and interpreted differently by investigators (Gladfelter 1997, 2000; Goldberg 1995; Horowitz 1979). Reconstruction of the environments of

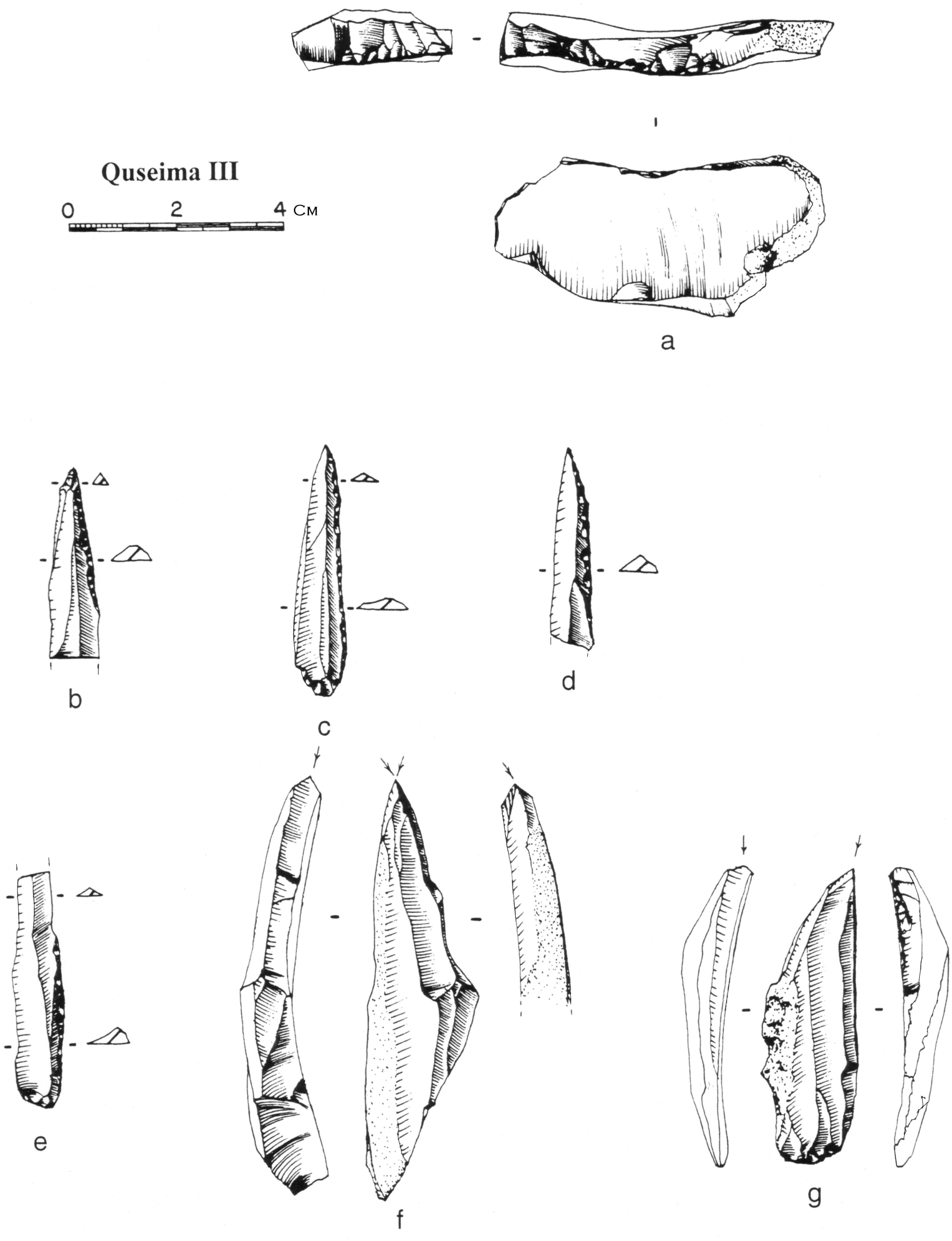


Fig. 9.3 Quseima III: a Core Tablet; b-e Partially Backed Bladelets; f-g Burins.

the Upper Palaeolithic hunter-gatherers rests primarily upon what is known from analyses of the sedimentary and geomorphic records. Faunal remains are prevalent in the caves and rockshelters of the central Levant (see Rabinovich this volume). Still, in the southern Levant, the Abu Noshra sites, southern Sinai (Phillips 1988), have preserved a faunal record not known from other open-air sites in this region. In part, this is a legacy of conditions of site preservation, and in part it is due to inadequate efforts to recover this kind of information, such as the use of wet sieving and flotation.

Hunter-gatherers of the Levantine Upper Palaeolithic period occupied and utilized a variety of niches and locales, and generally exploited locally available resources. The mosaic diversity of the primary (plant) biomass, and the association of different plant associations with one another has led some scholars to envision relatively small catchment areas with a variety of

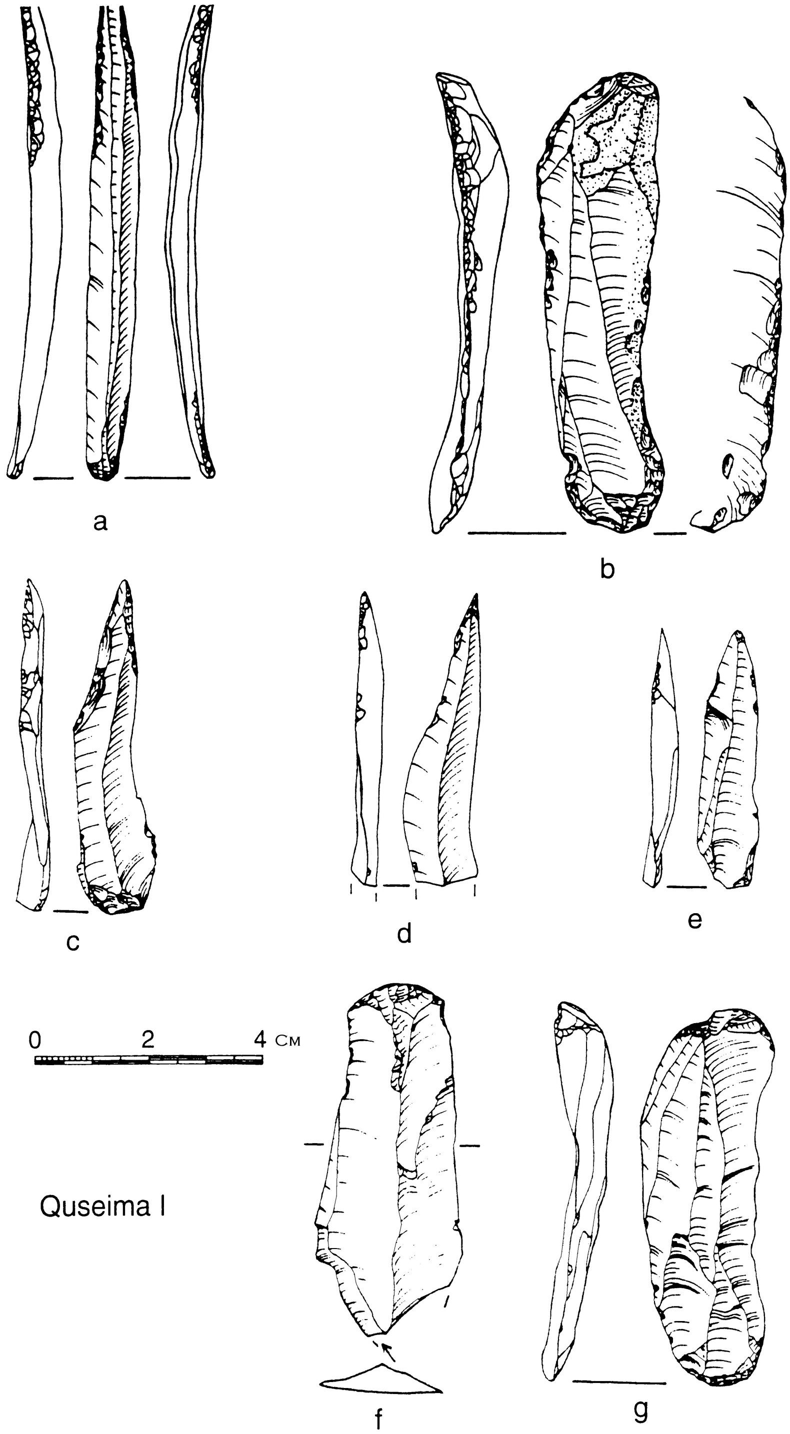


Fig. 9.4 Quseima I: a, c el-Wad Point; b, f-g Endscrapers; d, e Partially Retouched Blades.

seasonally available plant and animal species. We know much more about the faunal aspect of the subsistence base, but we can often infer plant associations available for exploitation from pollen analysis, and, occasionally from macro-botanical remains (see Bar-Yosef and Phillips 1977; Baruch 1994; Weinstein-Evron 1983; Phillips 1988). Knowledge of the primary biomass, in association with the topographic features of the central and southern Levant, is crucial for our understanding of the variability witnessed in the archaeological record, whether within or between archaeological traditions.

Upper Palaeolithic sites in the central and southern

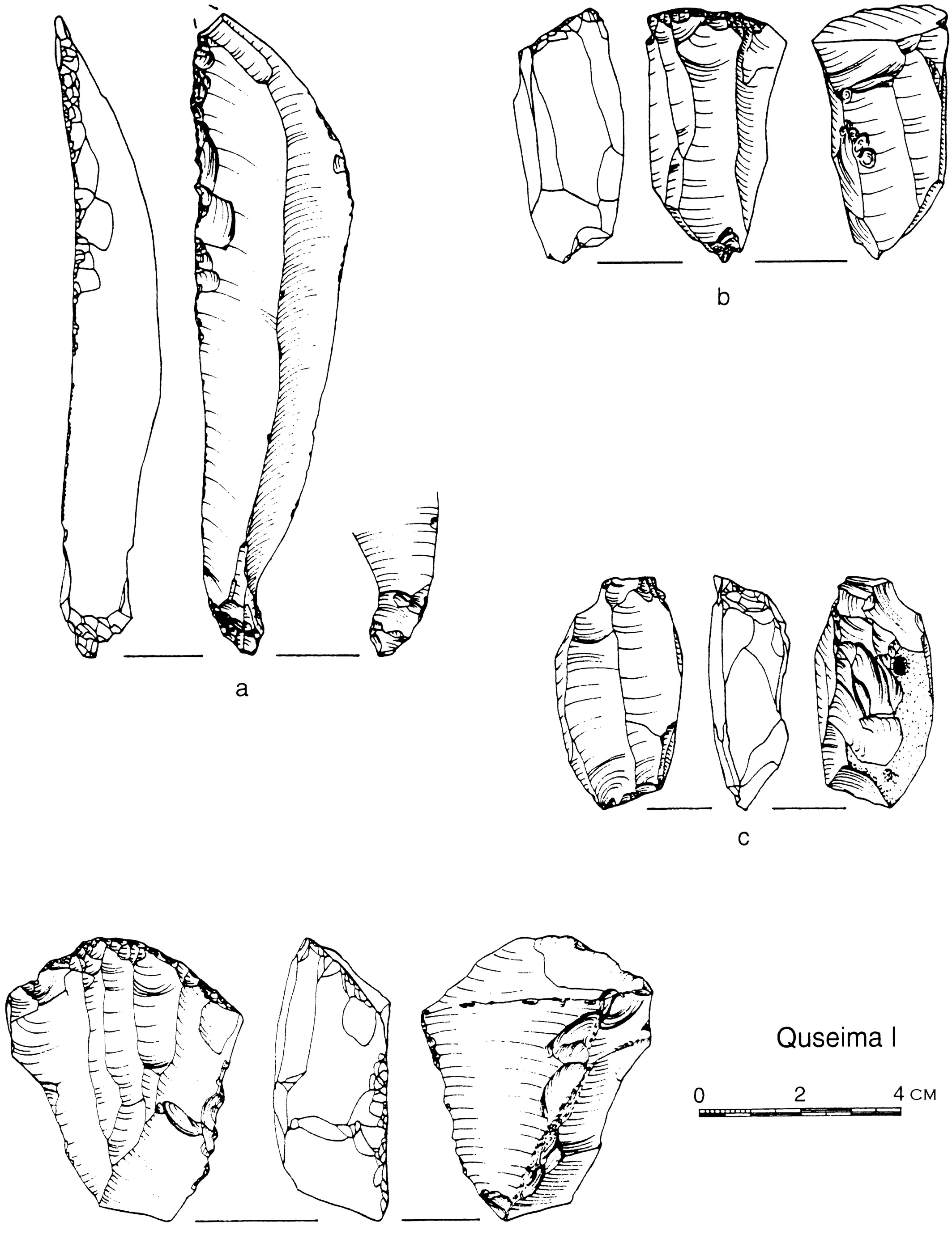


Fig. 9.5 Quseima I: a Retouched Blade; b-d Cores.

Levant intensely utilized several ecotones, which contribute to the nature of their site distributions over the landscape. Open-air sites in the southern Levant are located near permanent water, such as springs (Ein Qadis, Ein el-Qudeirat, Ein Mor, Ein Avdat, Ein Agev), or ponds and lakes (Abu Noshra, Wadi Hasa). In the central Levant rockshelter or cave sites, for example Ksar Akil, el-Wad, Kebara, and Qafzeh are located in association with olive-oak-pistachio forest settings, in generally hilly terrain. Water from springs is assumed to be close by, but not directly associated with these sites. However, the secondary (animal) biomass appears to be denser and contains a wider variety of larger species than that found further to the south. Cervids, such as *Dama mesopotamica, Capreolus capreolus,* infrequent *Cervus elaphus,* along with *Bos primigenius* are found in Ahmarian rockshelters, along with *Gazella gazella, Sus scrofa,* and a variety of smaller animals, such as *Lepus capensis, Testudo* sp., *etc.*

Fig. 9.6 Abu Noshra II: a, c-h Cores; b Core Trimming Element.

In southern sites it is rare to find faunal remains, but when found ostrich eggshell, and *Capra ibex* and *Gazella* sp. are often present (Bar-Yosef and Belfer 1977; Gilead and Bar-Yosef 1993). At the Abu Noshra sites in mountainous southern Sinai, where the orographic effect on the rainfall pattern is quite profound, *Bos primigenius, Sus scrofa, Equus asinus* and *Equus hemionus, Capra ibex and Gazella gazella*, along with fish and birds were taken near ponds, while oak and pistachio wood have been identified from the recovered charcoal (Phillips 1988).

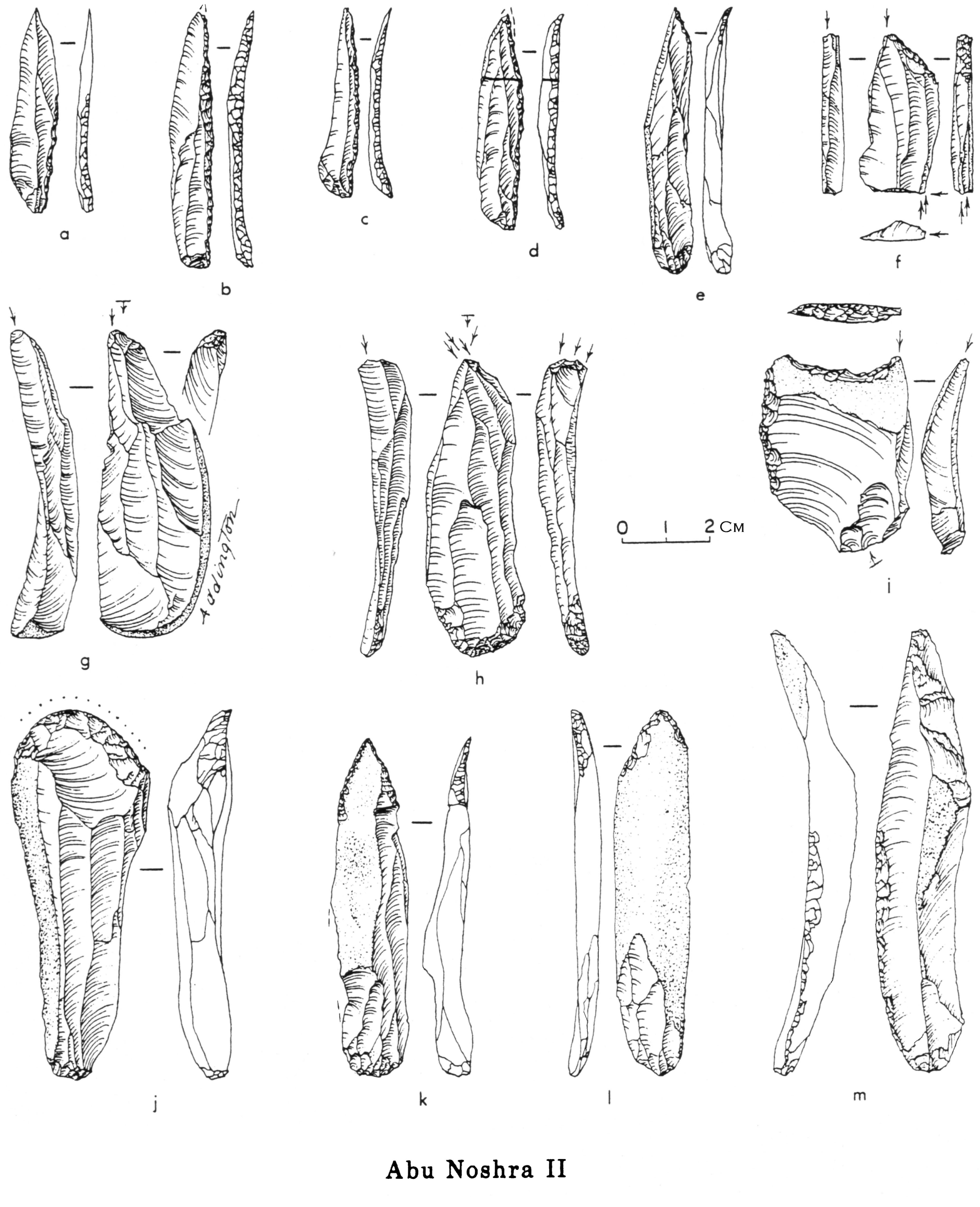


Fig. 9.7 Abu Noshra II: a-e Backed Bladelets; f-i Burins; j Endscraper; k-l Double Truncated Primary Blades (Points); m Partially Retouched Crested Blade.

Settlement Systems

When we view settlement systems in relation to subsistence patterns, there is a tendency to consider the patterning of prehistoric locales as representing the entirety of a subsistence system, even though movements and subsistence strategies may change from year-to-year as the availability of resources varies. Foraging and collecting result in different archaeological configurations, the former erecting a spatial pattern of regional, low-density scatters interrupted by higher-density artefactual clusters, the latter adding to this pattern locations indicative of resource procurement locales. The latter pattern develops because the activities involve extraction at many stopping-places in the ecological landscape, groups being sent out from a seasonal central place (Binford 1980; Phillips 1987b).

To a great extent, Upper Palaeolithic subsistence systems have been inferred from the spatial distribution

of sites (Phillips 1994). This approach assumes that a settlement system retains *de facto* internal variability. Conversely, in order to adopt the spatial patterning of sites as a basis for diachronic change in spatial organization, it must be assumed that cultural systems are internally homogeneous. In either event, the relationships among artefactual diversities, sizes of settlements and a systemic structure are inadequately understood in general, and in the Levant in particular.

The ecological terrain largely governs the movements of hunter-gatherers across a landscape. The mosaic of microenvironments is more important in determining short-term moves than is the regional environment; the former as well as the latter must be recreated, although this is not conventionally done. Factors at both local and regional scales affect the archaeological structure of sites of hunter-gatherers. Among others, two models have been proposed for the movement of early Upper Palaeolithic hunter-gatherers. That of Marks and Friedel (1977:153) is a regional one initially suggested for Upper Palaeolithic foragers in the Negev. They suggest a system of circulating mobility, practiced by highly transient, small 'family' units moving throughout the area during the course of an annual round, exploiting scheduled resources and reoccupying places. This model is based on their interpretation of the size of sites, which they believe indicates brief occupation, the modest quantity of archaeological residue, the nature of the lithic assemblages, and the reconstructed context of the sites. They propose, from observations in the Avdat region of the Negev, that climatic deterioration after about 40,000 bp, forced these early Upper Palaeolithic populations to move much more often than did their predecessors. They further suggest that... 'Therefore, the model would predict that the patterns seen in the Avdat/Aqev area would be confirmed in the rest of the Levant' (*ibid.* 183–184).

An alternative model for the pattern of early Upper Palaeolithic hunter-gatherers collectors in other regions, based on work in the mountainous zone of southern Sinai, has been suggested by one of us (Phillips 1987a, b). Phillips concludes that hunting was complemented by a mix of foraging and collecting as part of a risk minimization strategy. Because of predictably rich, easily accessed microhabitats, groups did not have to move as frequently. They dispatched task groups to procure raw materials and food. It is important to note that the environment of the Levant was regionally and locally different than that of today. For example, the site of Erq el-Ahmar in the Wadi Khareitoun, where today trees are rare and only found near modern settlements, contained *Cervus elaphus* and *Dama mesopotamica* during the early Upper Palaeolithic period, indicating a wetter and cooler local environment (Neuville 1951).

When we examine rockshelter and cave deposits where both Middle and Upper Palaeolithic deposits occur, it is obvious that the Middle Palaeolithic deposits represent the preponderance of deposition. In nearly every instance in the central Levant – at Kebara, el-Wad, and Qafzeh for example – the Upper Palaeolithic units are fewer and not as thick as the earlier Mousterian deposits (Turville-Petre 1932; Garrod and Bate 1937; Ronen and Vandermeersch 1972). However the intensity of occupation may actually be greater within each Upper Palaeolithic level than ever was the case in Middle Palaeolithic occupations. An example of such intensity of occupation in the Upper Palaeolithic would be the site of Ksar Akil, where each occupation during the Upper Palaeolithic, of both traditions (Ahmarian and Levantine Aurignacian), represents more intensive use of both the rockshelter and the surrounding environs (Tixier and Inizan 1981; Azoury 1986). Another example may well be the site of Boker A, where the published report indicates that an intense occupation and use of the area occurred in the earliest Upper Palaeolithic, apparently contradicting the idea that all Upper Palaeolithic occupations in the Avdat area were brief (Jones *et al.* 1983).

It seems that, however, regions existed in the Levant where more ephemeral Upper Palaeolithic occupations were the norm rather than the exception. An example would be the Lagaman (Early Ahmarian) of Gebel Maghara, where the assumed length of occupation of the 16 sites ranges from a day to a week or so.

The above implies that environmental constraints may be the cause of some of the regional settlement variability witnessed in the Upper Palaeolithic archaeological record. In contrast, areas which are less Mediterranean in climate and soils may very well prevent long term intensive utilization of the landscape, while areas such as southern Sinai or the Mount Carmel region, which were both wetter and cooler than today throughout the Upper Pleistocene, provided an ecology able to accommodate more intense and varied seasonal use of the landscape.

Conclusion

With the above consideration of subsistence and settlement in mind, we can now view lithic variability in the early Upper Palaeolithic in context. The variability that existed between diverse early Upper Palaeolithic assemblages can be partially attributed to the context of the archaeology and the nature of the raw material in terms of size, shape and the conditions of acquirement. Base camps, kill sites, and procurement sites may each have a different signature, therefore indicating inter-site variability within a region and between regions, if we can control for chronology. The best reported examples of early Upper Palaeolithic assemblages are those from the semi-arid southern Levant that belong to the Ahmarian tradition (Table 9.1).

Different manufacturing techniques exist within and between each of the Upper Palaeolithic traditions. As an example we can examine blade production during the Upper Palaeolithic. Both direct and indirect soft hammer blade production was used by Ahmarian flint knappers.

Although cresting and core tablets are the standard technique for core preparation in all Ahmarian assemblages (Ferring 1988; Jones *et al*. 1983; Phillips 1988), other core preparation techniques do occur occasionally (Phillips 1987b, Monigal herein).

Core tablets are produced in the core rejuvenation process when clast (nodule) sizes are large, *i.e*. Quseima I and III (Figs. 9.2–5), Qadesh Barnea 9 and Qadesh Barnea 601 (Phillips unpublished; Gilead and Bar-Yosef 1993), while it is only occasionally used at the Abu Noshra (Figs. 9.6–7) or Lagaman sites, where the clast sizes are much smaller. The finished blanks, which were turned into tools, also varied according to their eventual use and the manner in which they were hafted. Thus ogival-based backed bladelets from the site of Abu Noshra II show hafting marks on the proximal end (also found at the site of Ein Qadis IV in northeastern Sinai – Goring-Morris 1995a), whereas none of these are found in the Ahmarian sites of Qadesh Barnea (Figs. 9.2–3). It is our contention that the differences in the retouch of either the proximal or distal ends of these blades and bladelets are due to two concurrent tendencies: one the manner in which the piece is used and, secondly, the tradition which produced it. Thus, for example, the co-variance of finely retouched and backed blades and bladelets with el-Wad points in southern Levantine Ahmarian sites (see Table 9.1) can be attributed to their local, traditional, manner of hafting, rather than to their specific function. Function, however, cannot be excluded in all cases; thus an el-Wad point from Layer E at the site of el-Wad, from the Field Museum collection (Phillips and Saca in press), was used as an awl, while another el-Wad point from the site of Kebara (*ibid*.) was used as a point. Similar functional variability occurred at the Abu Noshra sites, albeit on other morphological types, such as truncated bladelets used as perforators (Becker 1999, herein).

Consequently, when analyzing a group of assemblages, it is necessary to take into account not only the techno-typological element, but also their context from both an intra- and inter-site point of view. For, variability in hunter-gatherer lifeways is a factor that must be dealt with if we are to understand how and why these groups moved through the landscape and survived the vagaries of their existence. Variability in the Levantine Upper Palaeolithic must be understood in its own terms, representing a series of decisions made by many groups, at many times, throughout the Levant, some of whom have left us little bits and pieces of their archaeological cultures.

Acknowledgements
We would like to thank O. Bar-Yosef, A. Belfer-Cohen, N. Goring-Morris, L. Keeley, and an anonymous reviewer for comments on various aspects of this paper.

Table 9.1 Ahmarian Tool Assemblages.

Tool Types=Percent	Abu Noshra I	Abu Noshra II	Abu Noshra VI	Lagama V	Lagama VI	Lagama VII	Lagama VIII	Lagama XI	Lagama XII	Lagama XV	Lagama XVI	QB 601	QB 9	Q I	Boker A	Boker BE/III
End-Scrapers	0	4.9	2	4	0	0.2	6.1	9.5	4.6	0.3	1	4.4	3.8	39.8	2.5	19.4
Burins	15.8	9	11.1	4.3	0	2.5	8.2	7.6	9.8	2	2.9	9.5	4.3	10.7	15.8	2
Perforators	6.1	2.1	2	0	0	0	2	0	2	0	0	0	0.6	0	0	0.2
Truncations	12.1	10.2	11.1	0.3	0	0.7	0	1	0.6	3.7	11.6	5	5.6	2.1	2	0.9
Notches/Denticulates	4.8	5.8	0	2.8	18.7	1.4	10.2	5.7	11.1	3.7	13.6	16.9	17.7	17.3	12.1	19.4
Knives	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Retouched Pieces	15.2	22.5	18	12.3	25	9.5	26.5	13.3	35.3	20	47.6	39.5	49.2	22.5	25.7	35.2
Multiple Tools	0.6	0.9	0	0	0	0	2	1	0	0	0	0.2	0	1.1	0.5	0
El-Wad Points	0	0	0	8	37.5	46.7	8.2	5.7	9.1	33.7	21.3	5	3.6	6.5	12.6	13.8
Backed or Finely Retouched Blades	44.3	39.4	55.5	55.2	0	36.9	20.4	46.7	20.9	36	0	19.1	14.1	0	26.4	3.9
Varia	1.2	5.1	0	1.2	18.7	2	6.1	9.5	5.9	2.4	13.6	0.6	1.1	0	2.5	5.2
N=	165	432	36	326	16	903	49	105	152	294	103	818	718	93	405	537

Key:
Abu Noshra [AN]=Phillips 1988 and unpublished
Lagama=Bar-Yosef and Belfer 1977
Qadesh Barnea [QB]=Gilead and Bar-Yosef 1982
Boker= Jones et al., 1983
Quseima [Q]=Phillips, unpublished

10. The Early Upper Palaeolithic at Üçağızlı Cave (Hatay, Turkey): Some Preliminary Results

Steven L. Kuhn, Mary C. Stiner, Kristopher W. Kerry and Erksin Güleç

Introduction

Üçağızlı Cave preserves a sequence of early Upper Palaeolithic assemblages spanning roughly 10,000 years and documenting the transition from the 'Initial Upper Palaeolithic' (*sensu* Marks 1990) to a somewhat later Upper Palaeolithic assemblage that resembles the Ahmarian. Unlike many recently excavated sites of similar age in the Levant, conditions of organic preservation at Üçağızlı Cave are excellent. In addition to rich lithic assemblages, the site yields faunal and molluscan materials that provide novel perspectives on Early Upper Palaeolithic (henceforth EUP) subsistence behaviour and ornament use. Assemblages from the most recent intact EUP layers (B-B4) embody many features of classic European Upper Palaeolithic industries, including bone tools and personal ornamentation, sometimes argued to be rare or absent in the Levant during this period. This paper summarizes results from the first two seasons of excavation in the site, with particular attention to the most recent Upper Palaeolithic deposits.

Archaeological Background

Üçağizli Cave is situated on the Mediterranean coast of the Hatay region of southern Turkey. Centred on the capital city of Antakya (ancient Antioch), the Hatay occupies the extreme northeast corner of the Mediterranean basin (Fig. 10.1). The Hatay is part of the modern state of Turkey, but topographically and ecologically it resembles the coastal Levant much more closely than it does Anatolia. As shall become apparent, the artefact assemblages also find their closest parallels in areas farther to the south. The site itself is situated directly on the seacoast about 15 km south of the mouth of the Asi (Orontes) river (Fig. 10.1). The surface of the archaeological deposits lies at an elevation about 17 m above current sea level.

Üçağızlı Cave was discovered by A. Minzoni-Deroche, who excavated at the site until 1990 (Minzoni-Deroche 1992). The current project, a joint effort of the University of Arizona and Ankara University, began with test excavations in 1997, followed by full-scale excavations in 1999 and 2000 (Kuhn *et al.*1999).

As it appears today, Üçağızlı Cave is the remnant of a larger collapsed cave. Pleistocene sediments are preserved in two main areas, the tunnel-like chamber to the southwest, and along what was once the back wall of the main chamber at the north end of the site (Fig. 10.2). Minzoni-Deroche excavated mainly in the southern chamber, whereas the more recent excavations have concentrated on the north end of the site. Breccias high on the back wall contain Epipalaeolithic artefacts, showing that at least three metres of deposits were lost to erosion subsequent to the cave's collapse. The substantial accumulation of material now lost to erosion also indicates that the cave collapsed well after the Upper Palaeolithic occupations discussed here. Despite this loss of sediments, a sequence of intact early Upper Palaeolithic deposits roughly three metres deep remains within the northern area.

Our excavations have exposed a north-south stratigraphic section nine and a half metres long (Fig. 10.2). The width of the trench varies from one to three metres. Although this is not an especially large area, it encompasses between one-half and one third of the surface of intact archaeological deposits at the site: to the immediate west of the excavation trench *in situ* deposits are truncated by an erosional slope just outside the current dripline. The archaeological sequence at Üçağızlı has been divided into eight cultural layers (B-I), each of which has one or more subdivisions (Fig. 10.3). The dominant bedding plane slopes down to the north, and the upper layers are more steeply inclined than the lower ones. The sediments are principally allochtanous, geogenic red clays (terra rosa) mixed with varying amounts of anthropogenic sediments, primarily calcite ash. Boundaries between layers are not generally marked by changes in sediment

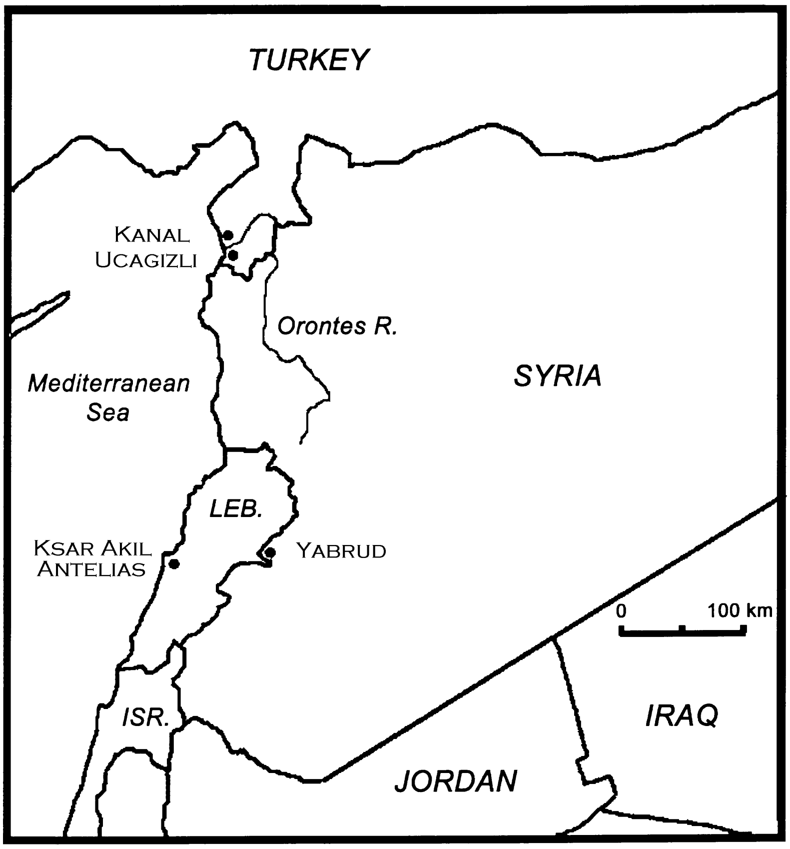


Fig. 10.1 Map of the northern Levant, showing locations of some sites mentioned in text.

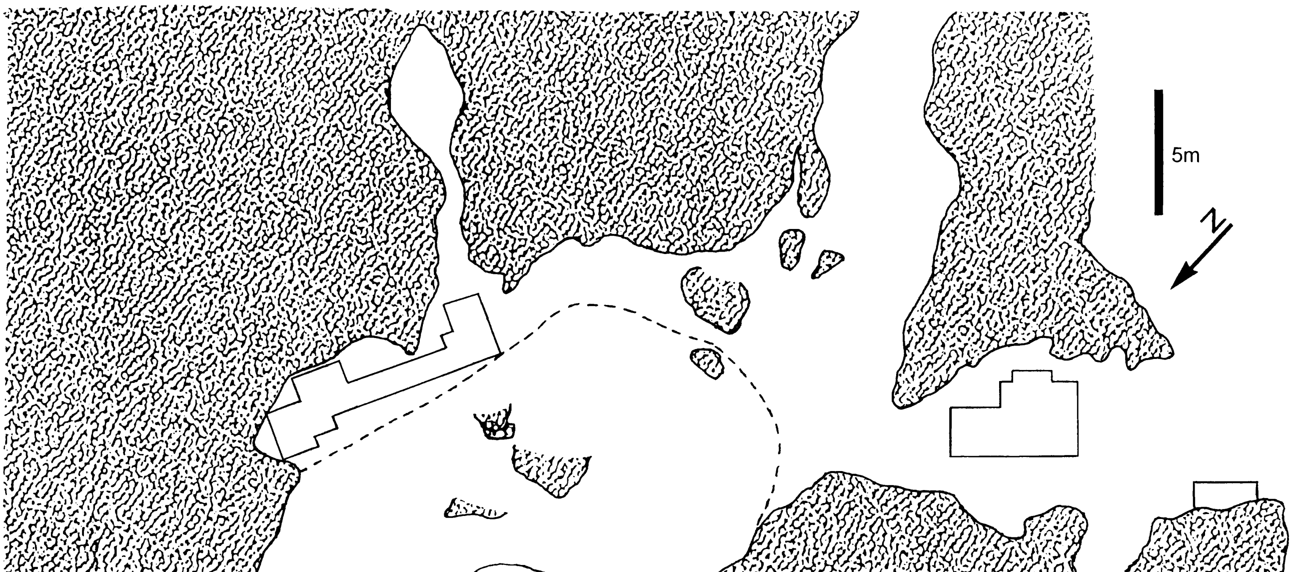


Fig. 10.2 Map of Üçağızlı Cave, showing locations of various excavation areas.

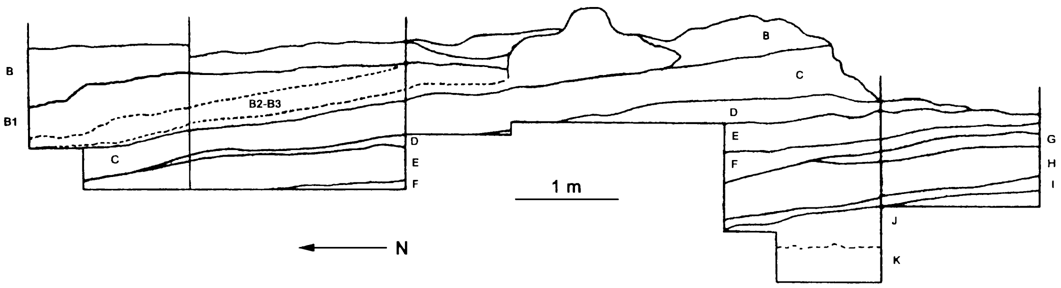


Fig. 10.3 Schematic stratigraphy, Üçağızlı Cave.

mineralogy but by fluctuations in the amount of anthropogenic contribution. Layers B, C, E, and G are relatively pure red clay containing little ash and varying quantities of artefacts and bone: layers C and G are poor in archaeological material, while layers B and E are richer. Layers B1-B4, D, F, and H contain numerous features, such as hearths and ash dumps, and are extremely rich in artefacts and bone. Underlying the Upper Palaeolithic sequence is a relatively pure clay stratum (J) and a thick layer of limestone *éboullis* (layer K), both nearly sterile. No evidence of pre-Upper Palaeolithic cultural remains has been found to date, although a few Mousterian artefacts have been collected from the vicinity of the site.

Broadly speaking, Upper Palaeolithic artefact assemblages can be divided into three main groups or components. The most recent Upper Palaeolithic component is found in layers B, B1, B2, B3, and B4, exposed mainly at the north end of the excavated area; it was also present in the area excavated by Minzoni-Deroche in the south chamber. Layers G-I contain the earliest assemblages, which resemble a comparatively late form of Initial Upper Palaeolithic such as is known from the sites of Ksar Akil (layer XXI) (Azoury 1986; Ohnuma 1988) and Boker Tachtit (level 4) (Marks and Kaufman 1983; Volkman 1983). The intervening strata (C-F) yield materials intermediate in character between the earlier and later components. A pocket of early Epipalaeolithic sediments was also present in another part of the site, but these are not in direct stratigraphic connection with layers B-I. The most recent Upper Palaeolithic assemblages, from strata B-B4, are the main subject of this paper.

Layer B consists of a highly uniform red-orange terra rosa clay. It does contain bones and stone tools but these are comparatively sparse compared to the underlying deposits. Layer B1 refers to thick deposits of nearly pure white calcite ash. Especially large ash concentrations are found both in the north end of the trench in squares D4 and E5, as well as farther south in squares H4/I5 (Fig. 10.3). These ashy deposits contain some bone and flint, and give the appearance of having been formed from a series of closely spaced dumping episodes. The contacts between layer B (the red clay) and the ash that defines B1 are quite sharp. Layers B2 and B3 contain a mixture of ash, organic material, and terra rosa, either coming from outside the cave or worked up from underlying sediments. These layers grade into B1 (and into each other), but here again the contact between B3 and the underlying red clay of layer C is quite sharp. Layer B4 is a yellowish-grey sediment found within a small pit or channel in the extreme northwest corner of the excavation trench (not shown in section). The highest artefact densities were observed in layer B3.

Despite the abundance of ash, layers B1-B3 are nearly devoid of macroscopic charcoal. Even flotation of the ashy sediments has not produced significant amounts of charcoal. Similar 'charcoal free' ash deposits have also been observed in other Levantine sites, including Kebara Cave (P. Goldberg, personal communication; herein). Whether this reflects the type of material burnt, the conditions of burning, or some kind of post-depositional mechanical or chemical destruction of charcoal is an interesting but unresolved geoarchaeological question.

Radiometric Dates

As noted above, there is comparatively little charcoal in the uppermost layers at ÜçaÈÏzlÏ Cave. Three AMS radiocarbon dates are relevant to establishing the ages of these layers. One date of 31,060±140 years bp (uncalibrated) on charcoal comes from a small pocket of hanging ash breccia cemented to the wall just above the top of layer B (AA35258). Two additional determinations, one of 29,130±380 (AA38203) and one of 32,670±760 (AA38201) come from layers B and B1, respectively. These last two determinations were made on aragonite from well-preserved *Monodonta* shells. As a control, a modern example of this species from the same area was also dated. This sample (AA38202) gave a 'post-bomb' age, indicating that no major adjustment in the radiocarbon ages need to be made to correct for hard-water effects and isotopic fractionation, at least in this species. Together, the three dates indicate that layers B-B1 date to sometime between 29,000 and 31,000 radiocarbon years bp: layers B2 and B3 are not likely to be much older.

The inconsistency between the dates run on charcoal and aragonite, the fact that shell dates are younger than the

carbon date from an overlying layer, is somewhat problematic. The shell carbonate dated was determined by FTIR (Fourier Transform Infrared spectroscopy) to be aragonite, and not calcite. This shows that the carbonates were essentially pristine, or at least that massive re-crystallisation had not occurred. Nonetheless, the dates appear slightly too recent. This may be the result of some sort of contamination or exchange of CO_2 with the modern atmosphere that did not result in significant recrystallisation of the shell carbonate. Attempts are underway to obtain additional age determinations.

Lithic Assemblages

The assemblages from layers B-B4 resemble each other closely in both typology and technology, and are described together. In the tables below, layer B is separated from the underlying ashy sediments (B1-B4). Collections from the first two excavation seasons are also presented separately. The 1999 sample has been studied in detail and the results are essentially final. Observations on the 2000 sample should be considered preliminary and only basic technological and typological information is available at present. Based primarily on the type of dorsal cortex present, two general classes of lithic raw materials can be recognized within the assemblages from Üçağızlı Cave. Some flints preserve a distinctively pitted and frosted outer surface typical of extensively rolled pebbles from fluvial contexts. No siliceous rocks are found on the beaches surrounding the cave today. The pebbles used in making the stone tools appear to come from ancient river terrace deposits, the closest of which are located 10–15 km inland. Pebble cortex is comparatively scarce in the deposits from layers B-B4, accounting for between 12% and 15% of the cortical pieces. More common is chalky nodular cortex, either fresh or slightly rolled, which accounts for 80–85% of the cortical pieces. The fact that soft cortical material remains on the specimens suggests that they were collected at or close to primary sources. The locations of primary flint sources are unknown, although we continue to conduct surveys in an attempt to locate them.

Table 10.1 shows the composition of the formal tool assemblages from layers B-B4: the classification follows Hours' (1974:12–14) typology for the Lebanese Upper and Epipalaeolithic sites. The current sample of retouched pieces consists of more than 1,300 specimens. Simple endscrapers (types B1, B2) are the dominant form of retouched tool by far. Long endscrapers (type B2) are more than three times as abundant as short endscrapers (B1), reflecting the predominance of blade blanks (Fig. 10.4). Retouched, pointed blades (types I2 and I3) and pieces with continuous or partial retouch (J1, J6) are the next most common general categories. We added a new type category, J6, for specimens with continuous retouch extending over less than 1/2 of one margin. A large proportion of these are blades with fine, marginal retouch localized near the proximal end. Burins are extremely scarce, accounting for 5% or less of the collection. Typical Aurignacian tool forms, such as carinated and nosed scrapers (types B4, B7, and B8), and blades with Aurignacian retouch (I4) are present but rare. Chanfreins and Emireh points, type fossils of the earliest Levantine Initial Upper Palaeolithic are absent, as are microliths (with one exception).

The retouched and pointed blades (types I2 and I3) are perhaps the most interesting group of retouched tools. These two classes subsume a wide variety of forms (Fig. 10.5). Typical el-Wad points (type I3), narrow blades with fine marginal retouch, are in the minority. Most of the pointed blades are larger, broader, and possess more invasive retouch than a typical el-Wad point. Some examples are distinctly asymmetrical, with only one retouched edge, so that the piece approaches a truncation or backed knife in form. However, true abrupt (backing) retouch is rare. Other pointed blades are very symmetrical. In a few cases the retouch is sufficiently invasive to justify classification as a *pointe á face plan*, as described for the material from Ksar Akil layers XVI and XVII (Azoury 1986). Whether this variety in the forms of retouched pointed blades reflects the existence of different functional types, or whether it represents a continuous range of morphological variability resulting from differences in blank form or artefact life histories remains to be established.

The preponderance of tools from the layers B-B4 at Üçağızlı Cave is manufactured on blade blanks. Blades are approximately three times as common as flakes among the tool blanks, and blades are more than twice as common as flakes within the larger size fraction of unretouched material (Table 10.2). The small core assemblage from layers B-B4, constituting less than 2% of the total lithic artefacts, reflects the laminarity of tool blanks and debitage (Table 10.3). A variety of core forms is present, including discoid and even Levallois types, but prismatic blade cores with two opposed platforms are the single most abundant form. The preponderance of bi-directional cores is echoed in a high proportion (47%) of bi-directional dorsal scar patterns on blades from layers B-B4 for which directions of dorsal scars can be determined. Blades tend to be straight in profile, with regular, parallel lateral edges and flat bulbs of percussion. Many have constricted or tapering proximal ends. In combination with high frequencies of punctiform or linear platforms and abundant evidence of platform grinding, these characteristics point to the use of soft-hammer or perhaps indirect percussion for blade manufacture.

Other, non-flaked, stone artefacts from layers B-B4 include a number of hammerstones and at least two pitted anvils. All hammerstones and anvils are made from pebbles of a hard, dense, greenish dioritic stone. This kind of rock does not occur on the coast today, but it can be obtained from the same terrace deposits as the 'pebble' flints described above. The anvils and some of the

Table 10.1 Typological composition of assemblages from layers B-B4, Üçağizli Cave. Type numbers follow Hours' type-list for the Upper and Epipalaeolithic of Lebanon (Hours 1974:12–14). Type J6, pieces with partial retouch, was added for this study (see text). Category totals in boldface.

			1999		2000	
			B	B1-B3	B	B1-B4
A2	sidescrapers and points		**5**	**4**	**3**	**7**
B	endscrapers		**128**	**245**	**87**	**126**
	B	indeterminate (fragment)	28	40	14	10
	B1	simple, short	12	45	13	27
	B2	simple, long	70	132	50	72
	B3	ogival	–	1	1	–
	B4	flat nosed	4	7	1	–
	B6	multiple	10	15	5	7
	B7	simple carinated	–	1	–	–
	B8	multiple carinated	–	–	–	2
	B9	lateral, on flake	–	1	–	–
	B10	circular	4	6	3	8
	B14	*divers*	–	1	–	–
D	burins		**12**	**17**	**3**	**6**
	D1	single blow	1	1	2	–
	D2	dihedral, axial	2	1	–	–
	D3a	dihedral, angle, 2 blows	2	2	1	5
	D3b/c	dihedral, angle, on break	4	6	–	–
	D4	multiple dihedral	1	1	–	–
	D7	on truncation, angle	2	5	–	1
	D8	multiple on truncation	–	1	–	–
E	*perçoirs*		**2**	**1**	**1**	**1**
F	backed blades/points		**6**	**17**	**4**	**6**
G	truncations		**6**	**9**	**4**	**10**
H	notches and denticulates		**11**	**25**	**7**	**4**
	H1, H2	notch	9	20	5	4
	H3	denticulate	2	5	2	–
I	special tools		**67**	**91**	**31**	**50**
	I2	pointed blade	53	80	26	47
	I3	el-Wad point	14	11	5	3
	I4	Aurignacian blade	–	–	–	1
J	retouched pieces and *pièces esquillées*					
	J1+J6	retouched blade	67	148	33	48
	J2	blade w/ inverse retouch	3	2	–	–
	J3	blade w/ alternating retouch	–	–	1	–
	J5	*pièces esquillées*	1	5	1	2
K	multiple tools		**8**	**18**	**1**	**1**
M	non-geometric microliths		**0**	**1**	**–**	**–**
Divers			**1**	**4**	**–**	**–**
Tool fragments			**5**	**10**	**4**	**3**
	TOTAL		*324*	*597*	*180*	*265*

hammers preserve traces of red pigment. However, this does not mean that pigment preparation was their primary purpose. It is likely that a few episodes of grinding ochre on a stone stain it for life.

Ornaments

One of the remarkable aspects of the Üçağızlı Cave sequence in general, and of the upper layers in particular, is the abundance of ornaments. Nearly 100 ornaments have been recovered from layers B-B4 to date. With a single exception these are all perforated or otherwise modified shells of marine and freshwater molluscs. The exception is the claw (terminal phalanx) of a very large predatory bird that has been notched for suspension. Table 10.4 contains a listing of ornaments from layers B-B4, by species, with both seasons combined. The most common ornamental molluscs are marine gastropods that have been intentionally perforated. Although 24 different species are represented, two taxa, *Columbella rustica* and *Nassarius gibbosula* account for over 80% of the ornament assemblage. The great majority of the species

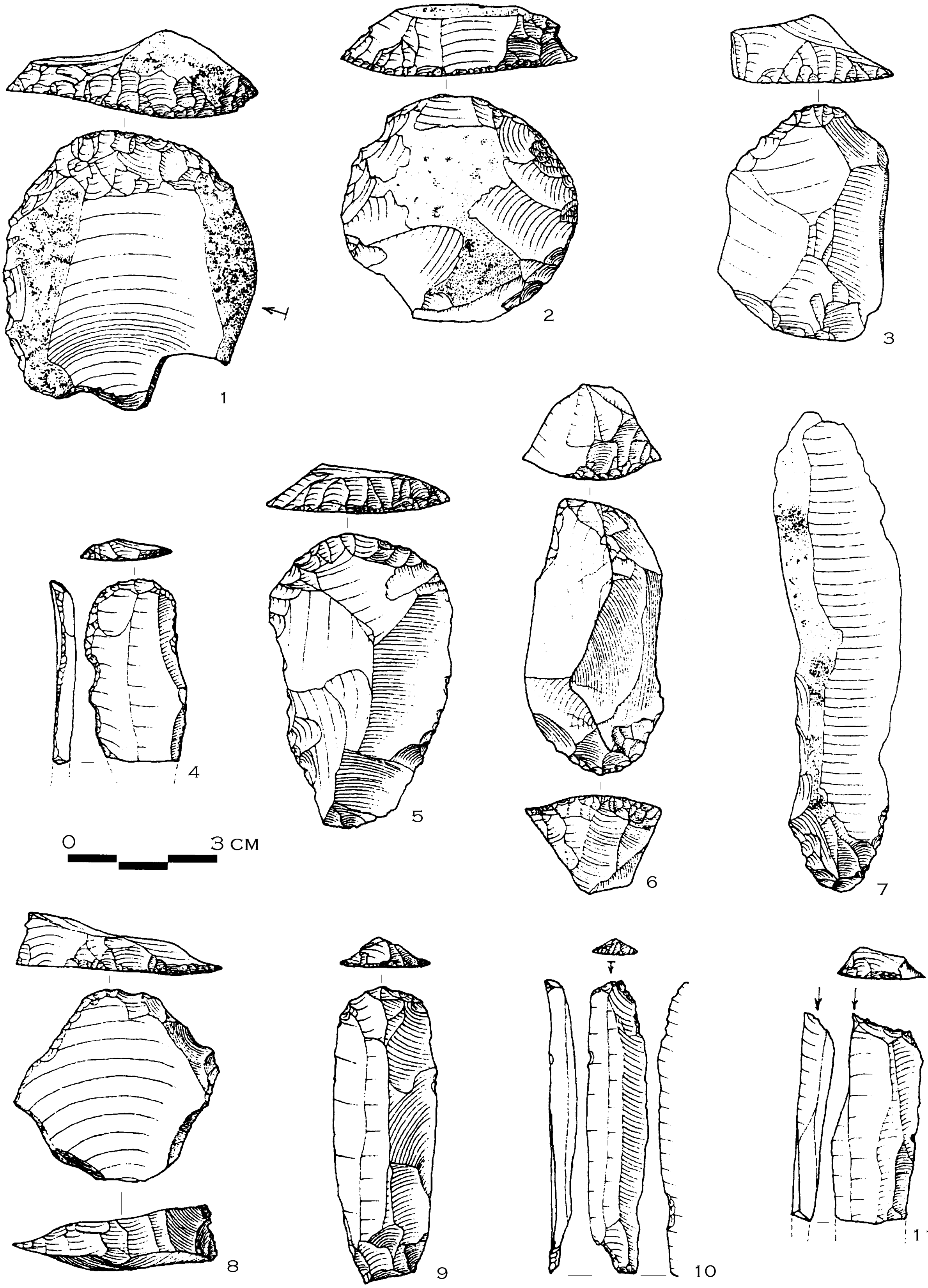


Fig. 10.4 Endscrapers and a burin from layers B-B3 (1999 excavation). Üçağızlı Cave.

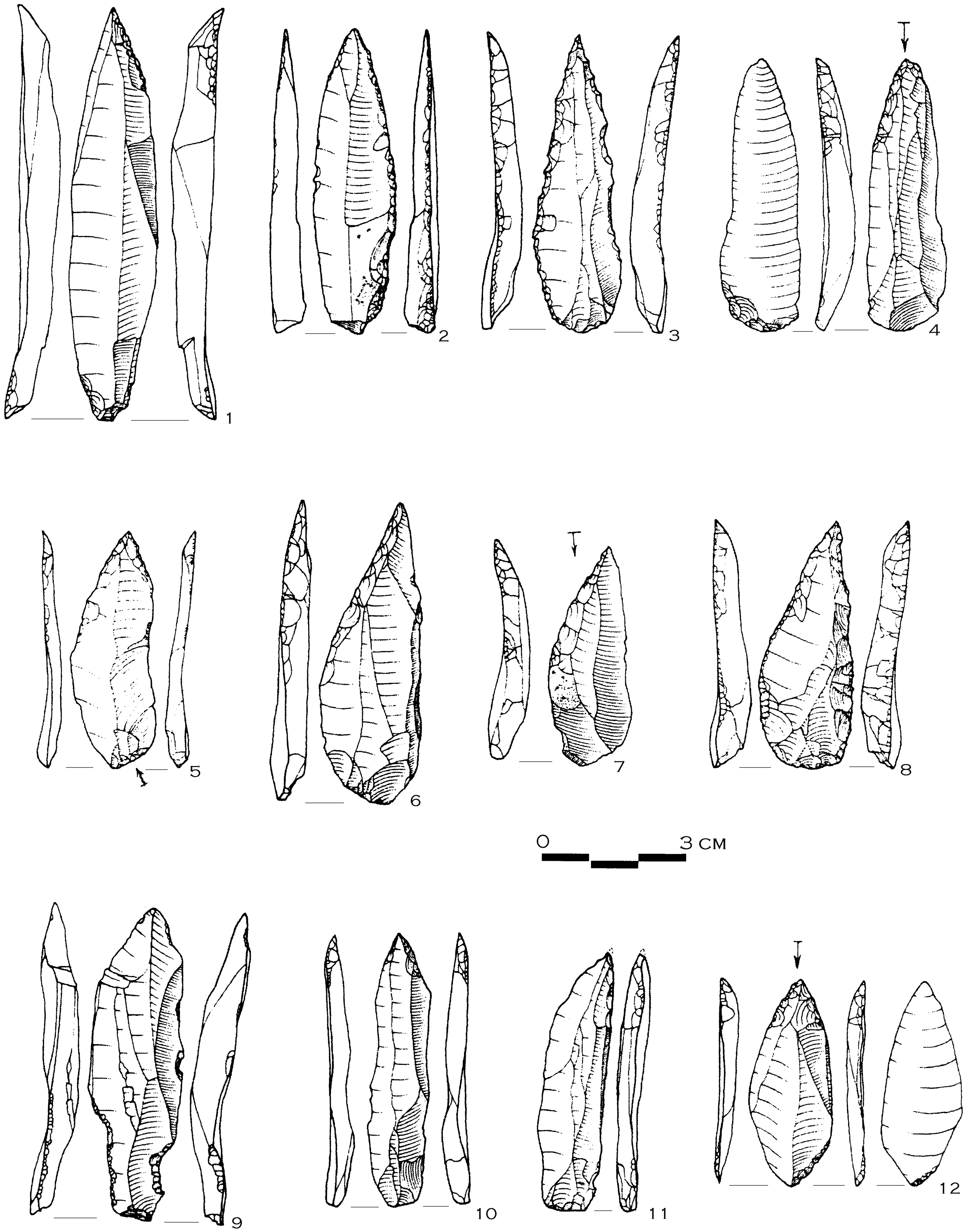


Fig. 10.5 Pointed blade and tools from layers B-B3 (1999 excavation). Üçağızlı Cave.

Table 10.2 Tool blank and debitage forms from layers B-B4, Üçağı1zı Cave.

	1999		2000	
	B	B1-B3	B	B1-B4
Tool blanks				
flakes	54	94	33	65
blades and bladelets	182	358	109	165
other forms	8	28	7	11
indeterminate	80	117	31	24
Unretouched (> 2.5 cm)				
flakes	124	157	(no data)	
blades and bladelets	287	397		
other forms	19	26		
indeterminate	95	115		
Unretouched (< 2.5 cm)				
flakes	537	464	(no data)	
blades and bladelets	221	144		
other forms	40	45		
indeterminate	700	721		

present are native to the eastern Mediterranean. However, the third most abundant gastropod, *Theodoxus jordanii*, actually inhabits fresh or brackish water. Its shells could probably have been collected in the nearby Asi (Orontes) river. These same species of marine and freshwater mollusc were used as ornaments throughout the Upper and Epipalaeolithic in the Levant (*e.g.*, D. Bar-Yosef 1989, personal communication 2000; van Regtern Altena 1962; Gilead 1995a; Kuhn *et al*. 2001).

Several characteristics of the ornamental mollusc species distinguish them from shells introduced into the site for other purposes, such as for food. First, the ornamental gastropod species are very small (7–18 mm in length) carnivorous or omnivorous species, with minimal food value. Most of the archaeological specimens of these taxa were modified by humans, usually by punching a small, irregular hole through the shell wall near the lip with some sort of pointed tool. These perforations are quite distinct from the small, very regular circular holes bored by predatory molluscs (see d'Errico *et al*. 1993; Stiner 1999a). Rarer forms of modification include incision or sawing. The ornamental shells are usually whole, seldom burnt, and a significant portion show evidence of abrasion by water or wave action, indicating that they were collected from beaches. In contrast, the species consumed as food are much larger and more common herbivorous types (see below). In archaeological context the food shells are almost always fragmentary and frequently burnt, but never wave-worn, indicating that they were collected while alive.

Bone tools

A total of 14 bone and antler artefacts were recovered from layers B-B3 during the 1999 and 2000 excavation seasons. They range from very small, needle-like pieces less than 3 mm in diameter, made from splinters of compact bone, to larger awls, 'points', or pins, up to 8 mm in diameter. The larger objects are manufactured of either compact bone or antler. The bone and antler tools are neither elaborate nor especially numerous, but they do indicate that the use of tough organic composites was part of the technological repertoire of the inhabitants of this site 30,000 years ago.

Fauna

Vertebrate and mollusc remains from layers B-B4 at Üçağızlı Cave provide evidence of a diversified subsistence base encompassing both terrestrial and marine resources. Terrestrial prey dominates the fauna. The three most common medium and large game species are roe deer (*Capreolus capreolus*), wild goat (*Capra* sp., probably *Capra aegagrus*), and fallow deer (*Dama mesopotamica*), in order of abundance. Both wild cattle (*Bos primigenius*) and wild pig (*Sus scrofa*) are present in smaller but significant quantities. Small game is

Table 10.3 Core forms from layers B-B4, Üçağızlı Cave.

	1999		2000		
CORE FORM	B	B1-B3	B	B1-B4	Total
tested nodule	3	4	–	–	7
disc- unifacial	1	1	1	–	3
disc- bifacial	1	–	–	1	2
centripetal Levallois	–	2	1	–	3
unidirectional Levallois	–	1	–	–	1
bidirectional Levallois	–	1	–	–	1
single plat. flake/blade core	1	2	–	–	3
opposed plat. flake/blade core	3	3	2	1	9
single plat. prismatic blade core	1	1	2	2	6
opposed plat. prismatic blade core	2	11	1	2	16
bipolar core	–	1	2	2	5
amorphous core	–	2	–	–	2

Table 10.4 Percent NISP, ornamental molluscs from Üçağızlı Cave (1999 and 2000 samples combined).

Taxon	LAYER B	B1-B4
MARINE MOLLUSCS		
Class: Gastropoda		
Calistoma laugier	–	<1?
Gibbula adansoni	1	–
Gibbula richardi	2	1
Gibbula leucophaea	<1	<1?
Gibbula turbanoides	1	–
Gibbula sp.	1	–
Naticarius Dillwyn	<1	–
Nevrita josephina	<1	<1
Naticarius millepunctata	<1	1
Columbella rustica	33	44
Pisania maculosa	–	<1
Nassarius gibbosula	50	44
Pyrinella conica	<1	–
Hinia costolata	–	<1
Conus mediterraneus	1	<1
Class: Bivalvia		
Glycymeris sp.	3	3
Acantho. tuberculatum	2	<1
Cerastoderma edule	2	<1
Clausinella fasciata	–	<1
Mactra stultorum	<1	–
other (indeterminate)	<1	–
FRESH & BRACKISH WATER MOLLUSCS		
Class: Gastropoda		
Theodoxus jordani	3	3
Melanopsis praemorsa	<1	–
Class: Bivalvia		
Potomida littoralis	<1	–
TOTAL NISP	385	481

dominated by marine species. Two types of rock-dwelling gastropod, *Patella* sp. and *Monodonta turbinata* were consumed extensively. Tortoise (*Testudo graeca*) and a variety of bird species are the main forms of terrestrial small game. Carnivores include fox (*Vulpes* sp.) and bear (*Ursus arctos*).

Zooarchaeological remains from layers B-B4 are consistent with recent analyses of changing diet breadth in the Mediterranean basin from the Late Mousterian through Epipalaeolithic (Stiner *et al*. 1999, 2000). The data from Üçağızlı provide evidence for early stages of dietary expansion, the inclusion of fast-reproducing but elusive prey such as birds, in the early Upper Palaeolithic. Only later, in the Epipalaeolithic, is there evidence for extensive use of small terrestrial mammals such as lagomorphs at this site.

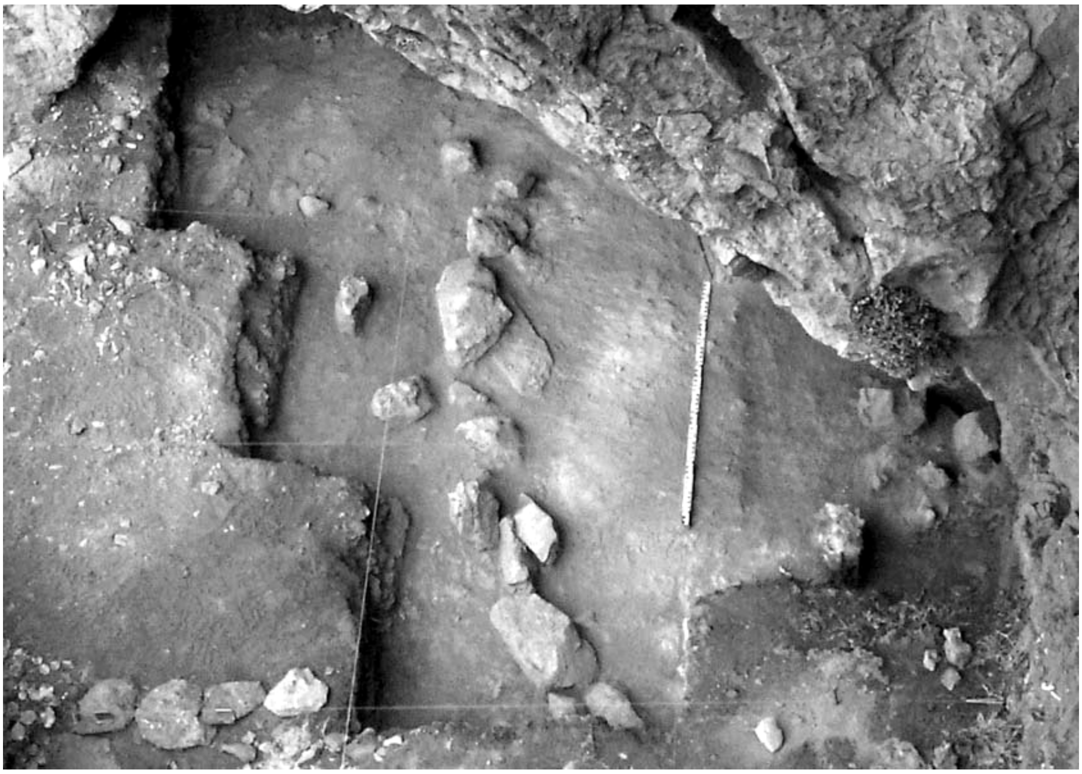
Elevated frequencies of *Capreolus*, along with the presence of both wild pig and bear, suggest relatively heavy vegetation. Apparently a substantial degree of forest cover prevailed in the area of the site at the time layers B-B4 were deposited. The abundance of shellfish remains also suggests that the sea level was relatively high, and the shoreline fairly close to the cave. Combined with radiometric dates, faunal data thus link the occupation to a relatively warm, wet interval late within Isotope Stage 3. The predominance of terrestrial game in such close proximity to the sea may simply be testament to a very rich terrestrial environment. Local topography could also have made Üçağızlı a particularly suitable base for the hunting of terrestrial game. The drainages closest to the site are short and extremely steep, with high, nearly vertical walls. This box-canyon-like configuration would have made the valleys well suited for ambushing or corralling prey.

Features

Üçağızlı contains a variety of features related directly or indirectly to burning. There are no well-defined, constructed hearths in the upper part of the sequence. At most, fireplaces in layers B-B3 consist of lightly burnt patches of sediment, and even these are difficult to identify and delineate. The absence of formally constructed hearths could well be a function of the fact that intact sediments are confined to the very back of the cave. Alternatively, hearth features may have been obliterated by subsequent human activity. On the other hand, massive accumulations of ash mixed with bone and artefacts, up to 60 cm thick, hint at extensive use and maintenance of fireplaces somewhere in the cave (see Goldberg herein).

In 1999, the remains of a simple structure were uncovered in the northeastern part of the excavation, within layers B1-B2 (Fig. 10.6a,b). This feature consists of a single arched course of limestone blocks, each 20–40 cm in length. The blocks form a 'wall' running roughly parallel to the back wall of the cave at a distance of 1.5 to 2 m from it. The alignment is clearly artificial: it corresponds with neither the cave's dripline nor any obvious fault or crack in the roof, and there were no blocks of comparable size in the surrounding sediments. Moreover, several of the blocks were set on edge rather than resting on their broad faces. Ash was somewhat concentrated 'inside' (east of) the row of stones, and sediments 'outside' (west) of it were distinctly less ashy. Artefacts, including ornaments, are abundant between the row of stones and the back wall of the cave. However, it appears that larger pieces, including cores, hammerstones, and anvils, are concentrated to the north and west of the 'wall'.

This feature has no precedent in the Upper Palaeolithic of the Levant. Its function remains ambiguous, but based on analogies with ethnographic cases the working hypothesis is that the feature delineates a bedding area in the back of the cave (*e.g.*, see Binford 1983:160–162). The concentration of ash could be the output of small,



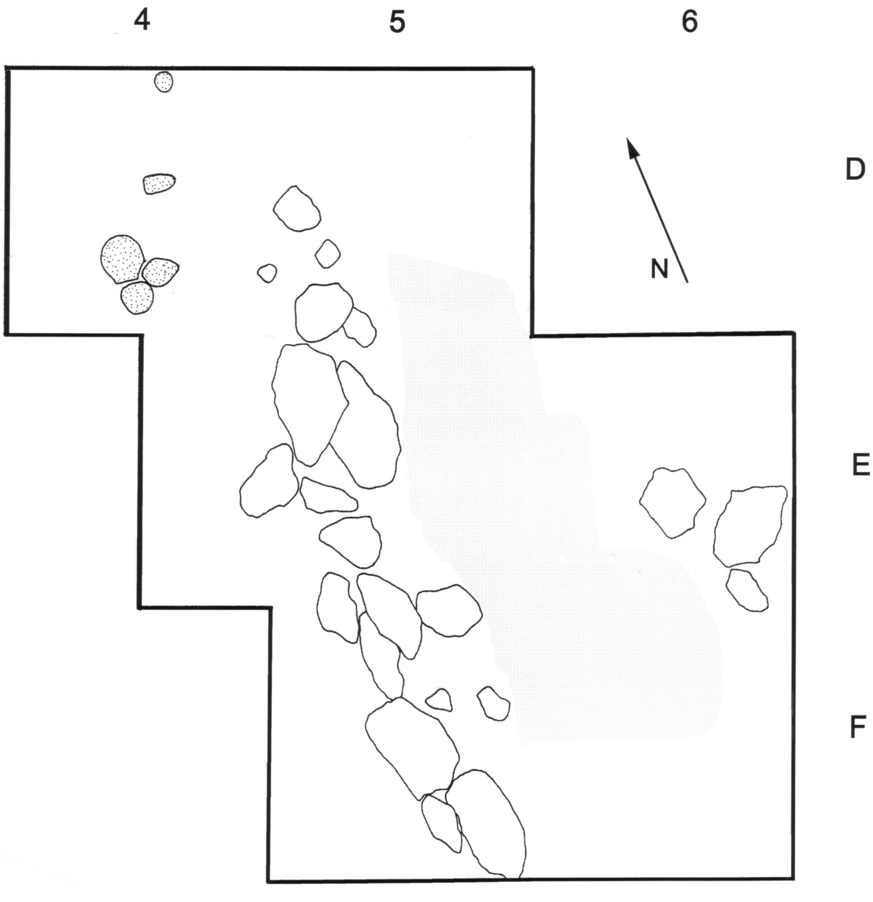


Fig. 10.6 a, Photograph of stone alignment in layers B1/B2, Üçağızlı Cave Scale is one metre long; b, Plan of stone alignment. Light shading indicates ashy sediment. Objects with speckling are artefactual (hammerstones and anvil).

unstructured fires constructed to warm sleepers, or it could be the residue of burnt bedding material such as grasses and foliage.

Comparisons and Discussion

There is little in Turkey with which to compare the assemblages from Üçağızlı Cave, as it is one of just a handful excavated sites located within the boundaries of the country that contain documented early Upper Palaeolithic deposits. Recent compendia (*e.g.,* Harmankaya and Tanındı 1996; Schyle 1992) list a number of other sites in Turkey reported to contain Upper Palaeolithic deposits, but few of these reports have been verified (Özdoan 1998). One site, Kanal, located on the Mediterranean about 4 km north of Üçağızlı Cave (Bostancı 1968), contained a similar type of initial Upper Palaeolithic, and may have possessed later Upper Palaeolithic layers as well. Karain Cave, located several hundred kilometres to the west near Antalya, is best known for its extensive Middle and Epipalaeolithic deposits, but a thin stratum yielding what appears to be an Aurignacian assemblage was discovered in Karain B in 1998 (Yalçinkaya and Otte 1999). The remarkable scarcity of definite Upper Palaeolithic sites in Turkey is partially attributable to the lack of systematic survey for Pleistocene deposits. Nonetheless, even in well-studied areas, such as the region around Antalya, the early Upper Palaeolithic appears to be exceedingly rare.

The best comparisons for the Üçağızlı Cave assemblages come from sites along the coast to the south, in the area of Beirut, Lebanon. Assemblages from layers XVI and XVII at Ksar Akil (Azoury 1986; Ohnuma 1988) appear to be a particularly close technological and typological match, reflected not only in the frequencies of points, burins and endscrapers, but in the form of blades and nature of retouch. The nearby sites of Antelias (layer IV) (Copeland and Hours 1971) and Yabrud II (layers 4 and 5) (Bachdach 1982; Ziffer 1981) also yielded materials that appear to be quite similar to what has been uncovered in layers B-B4 at Üçağızlı. All of these assemblages resemble the Early Ahmarian from the southern and central Levant in their general characteristics, especially the heavy reliance on blades and the abundance of points. However, the Üçağızlı assemblages contain many more endscrapers, and many fewer burins and pointed blades than do typical Ahmarian assemblages from the arid southern and eastern Levant. Other details, including fine marginal retouch and comparatively narrow blades, further distinguish the Ahmarian sites in the south from the northern cave assemblages. An apparent exception is the collection from Lagama XVI from the Sinai (Bar-Yosef and Belfer 1977:72–76), but this is a single small sample.

Recently, assemblages from Ksar Akil and Yabrud, formerly called 'Levantine Aurignacian', have been grouped with the Ahmarian instead (Bergman 1987a; Schyle 1992). This is consistent with a continuing reconfiguration of the term 'Aurignacian', from its original reference to all early Upper Palaeolithic assemblages, to a more specific term designating assemblages with a restricted array of typological and technological features (Belfer-Cohen and Bar-Yosef 1999; Gilead 1991; Marks and Ferring 1988; Ronen 1976). Converting the Aurignacian from a 'catch-all' typological designation is certainly desirable, but in the process we should be cautious not to turn the Ahmarian into another junk category – comprising all blade-dominated Levantine Upper Palaeolithic and even early Epipalaeolithic assemblages (see Bergman and Goring-Morris 1987; Boëda and Muhesen 1993; Ferring 1988, amongst others). Other than historical precedent there is no compelling reason that the entire early Upper Palaeolithic should be assigned to two (or one, or three) general 'cultural phyla'. In fact, the Ahmarian/Levantine Aurignacian distinction is not always clear in the southern Levant (Belfer-Cohen and Bar-Yosef 1999; Coinman 1998a; Kerry 2000), and there is no reason to expect that everything from the northern Levant should fall neatly into just two groups either. The material from layers B-B4 at Üçağızlı is certainly more like the Ahmarian than the Aurignacian, *sensu stricto*, but how much more similar remains an open question.

It is worth noting that our dates for layers B-B4 at Üçağızlı Cave do not fit well with dates from Ksar Akil reported by Mellars and Tixier (1989), despite similarities in the lithic assemblages. These authors report two dates of *ca*. 32,000 years bp for levels argued to correspond to Ewing's layers IX or X. The archaeological materials from the upper part of Üçağızlı Cave most closely resemble Ksar Akil layers XVI and XVII: certainly, they are quite unlike the 'Levantine Aurignacian' from above layer XIV at Ksar Akil. Compared with results from Ksar Akil, the dates reported here seem too recent, or *vice versa*. This apparent discrepancy could have a number of sources. As discussed above, it could be a result of contamination of the aragonite in the marine shells dated with modern carbon, or movement of samples within the deposits, issues that can only be resolved by obtaining additional dates. It is also possible that correspondence between Ewing's and Tixier's excavation trenches at Ksar Akil has been reconstructed incorrectly. Finally, it might be the case that Upper Palaeolithic typological and technological diversity in the eastern Mediterranean was more extensive than current models allow, so that no single stratigraphic sequence can adequately characterize the entire region.

Although the results of our analyses are preliminary, findings from the first two years of excavation at Üçağızlı Cave do point to a reconsideration of some widespread generalizations about the Levantine EUP. It is sometimes stated that indicators of 'modern human behaviour' such as bone tools, ornaments, and art are scarce in the Levantine Early Upper Palaeolithic (*e.g.*, Clark and Lindly 1989; Gilead 1991, 1995a), even prompting the suggestion that this complex of characteristics is actually

part of a specialized northern Eurasian adaptive complex (Foley and Mirazon-Lahr 1997). In point of fact, ornaments and bone tools are present in association with some Levantine Aurignacian assemblages, *i.e*., Hayonim D (Bar-Yosef and Belfer-Cohen 1988; Belfer-Cohen and Bar-Yosef 1981). Where they are conspicuously scarce is in Ahmarian, or non-Aurignacian sites.

The abundance of ornaments, as well as the presence of significant numbers of bone tools in layers B-B4 at Üçağızlı Cave seems to run counter to generalizations about Early Ahmarian and Ahmarian-like assemblages. However, other sites in the northern Levant have yielded these same elements. Shell ornaments are abundant throughout the Upper Palaeolithic sequence at Ksar Akil (van Regtern Altena 1962; Kuhn *et al*. 2001), and both shell beads and bone points were recovered from layer 4 at Yabrud II (Rust 1950). What remains evident is that elements such as beads and bone tools are less well represented in the Ahmarian of the central and southern Levant. Once again, it seems that there are significant geographic contrasts within the Levantine EUP, over and above the traditional bipartite division between Ahmarian and Aurignacian. The question of regional variability within the Ahmarian (or non-Aurignacian assemblages) of the Levant is ripe for future investigation.

Acknowledgements

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11. Technology, Economy, and Mobility at the Beginning of the Levantine Upper Palaeolithic

Katherine Monigal

Introduction

Dated to about 38,000 bp, the site of Boker A in the central Negev, Israel, contains one of the earliest known Ahmarian occurrences. Extensive lithic conjoining and technological analysis of the knapped assemblage have shed new light on reduction strategies and tool manufacture used during this initial stage of the Upper Palaeolithic. A single, highly consistent method of core reduction produced blades/bladelets of a particular shape, which, along with by-products of core preparation and maintenance, were in turn used for a specialized toolkit. An understanding of the full suite of core reduction, tool manufacture, and spatial distribution at Boker A offers insight into the activities of the very mobile Early Ahmarian occupants. The simplicity and efficiency of the core reduction strategy and tool production suggest that conservation of energy on the part of the knapper through the rapid production of useful blanks – blades, bladelets, as well as the more robust cortical products and core trimming elements – was a major, and not unworthy, goal.

Site Location and Background

Situated in the Avdat/Aqev area of the Central Negev, about 25 km north of Mitzpeh Ramon (Fig. 11.1), the sites of Boker (D100) were discovered and excavated in the early 1970's as part of the Central Negev Project (1969–1983), directed by A. E. Marks (Marks 1976a, 1977a, 1983a). The site complex is located within a terrace remnant, 1000 m² in area, in the lower end of the north-south Zin drainage, about 300 m south of where it converges with the east-west trending Nahal Havarim. Boker consists of four spatially and chronologically isolated loci: Areas D and A contain artefacts relating to the early Upper Palaeolithic, while Areas BE and C, dating to around 24,000 bp (Marks 1983b:37), pertain to the later Upper Palaeolithic. Boker A, in contrast to the other multi-component loci in the complex, contains a single cultural horizon, located about 5 m above the present-day wadi bed.

Boker A provided two minimal radiocarbon dates on charcoal of >33,600 bp (SMU-187) and >33,420 bp (SMU-260); and a third, more precise date, albeit with a large standard error, of 37,920±2810 bp (SMU-578) (Marks 1983b:37). These dates are at the limit of the radiocarbon technique and, being on charcoal, are more susceptible to contamination from the surrounding sediments (Lanting and Plicht 1995). Yet, they have been indirectly supported by U/Th dating of travertines in the Nahal Mor (Schwarcz *et al.* 1979), and by the recent dating of Ahmarian layers at Kebara to 43–36,000 bp (Bar-Yosef *et al.* 1996). Geomorphological, sedimentary, and pollen analyses of the Boker site complex (Goldberg 1983; Goldberg and Brimer 1983; Horowitz 1983) indicate that Boker A was occupied during a relatively wet climatic phase when the inhabitants would have had access to diverse open steppe and Mediterranean floral and faunal communities. During the earlier (D and A) occupations of Boker, the sites were adjacent to a permanent water source, either in the form of a spring pool or a constantly flowing wadi stream (Goldberg and Brimer 1983; Horowitz 1983). Flint raw material sources are ubiquitous in the Avdat/Aqev area, and the inhabitants of Boker A would have been within 200 m of multi-form, readily available supplies. Major sources included horizontally bedded laminae and large nodules in Nahal Mor, as well as derived small nodules and large cobbles in the wadis, at the base of cliffs, eroding out of the terraces, and in conglomerates in the immediate area of the site (Munday 1976).

Most of the technological and typological studies of the Boker A material were performed in the evening, after a full day in the field, so while pieces were occasionally conjoined, none of the excavators had the time or the energy to engage in a full-fledged refitting project. As part of the arrangement between the Israel Antiquities Authority and the Central Negev Project, after each excavation season material from every other quarter square metre unit of Boker A was left in Israel, while the remainder has been housed at Southern Methodist University. This agreement ensured that each party had a random and representative

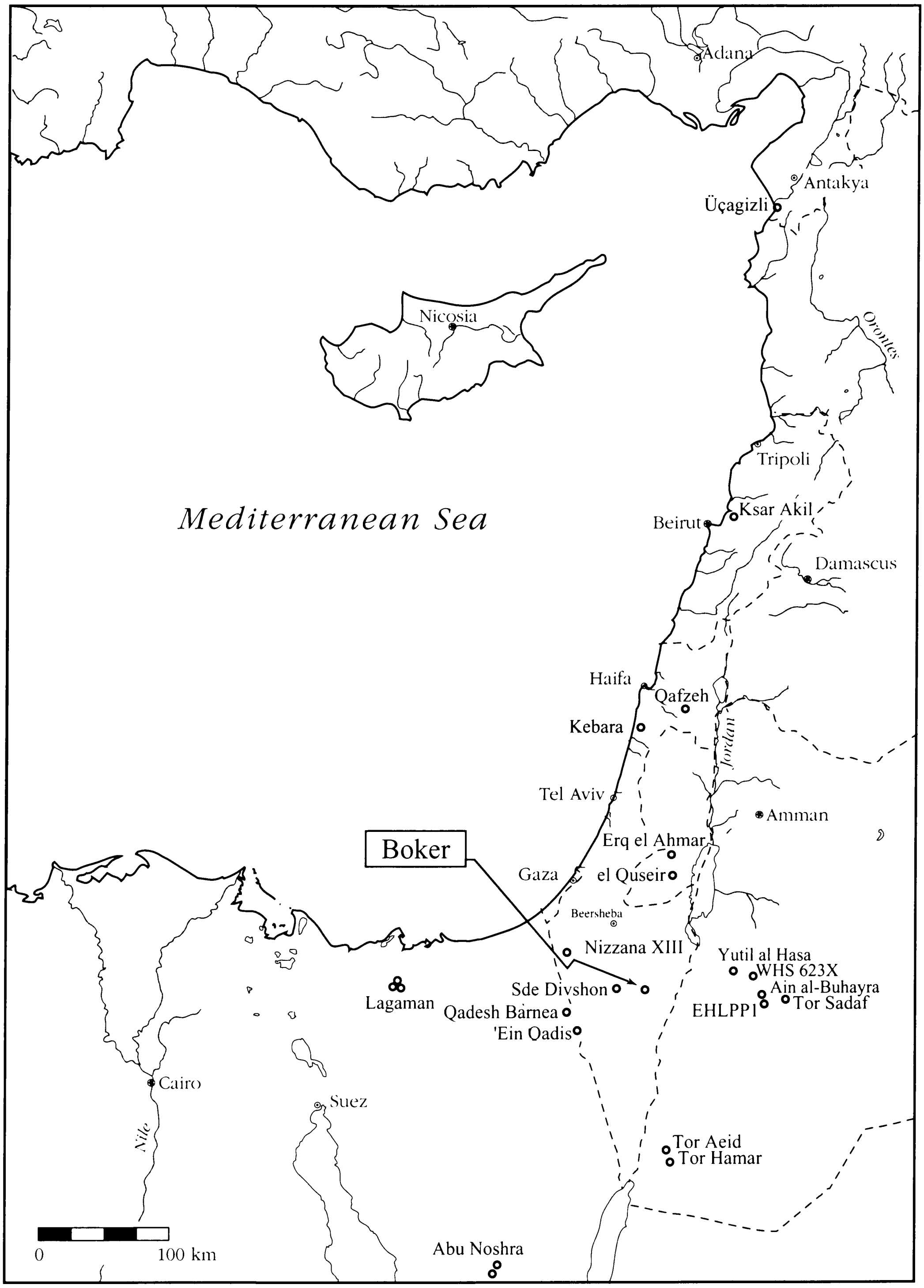

Fig. 11.1 Map of the Levant showing the location of Boker A and other Early Ahmarian sites.

sample, but it did hinder the refitting process. Attempts in 1994 to refit the material at SMU eventually came to an impasse when it became evident that the adjacent square metre units, then in Israel, contained necessary pieces for the study. The IAA kindly loaned SMU their material for a short time, in exchange for returning the entire assemblage to the Authority after the end of the refitting project.

The Boker A material is a rich and sizeable assemblage, numbering over 5,000 pieces, excluding chips and chunks. The lithic material comprises a pristine and unpatinated mostly high quality flint. Unfortunately, it is rather homogenous, with only minor variations in the shade of its brown colour, in lustre, texture, occasional mottling or banding, and the relative chalkiness of cortex.

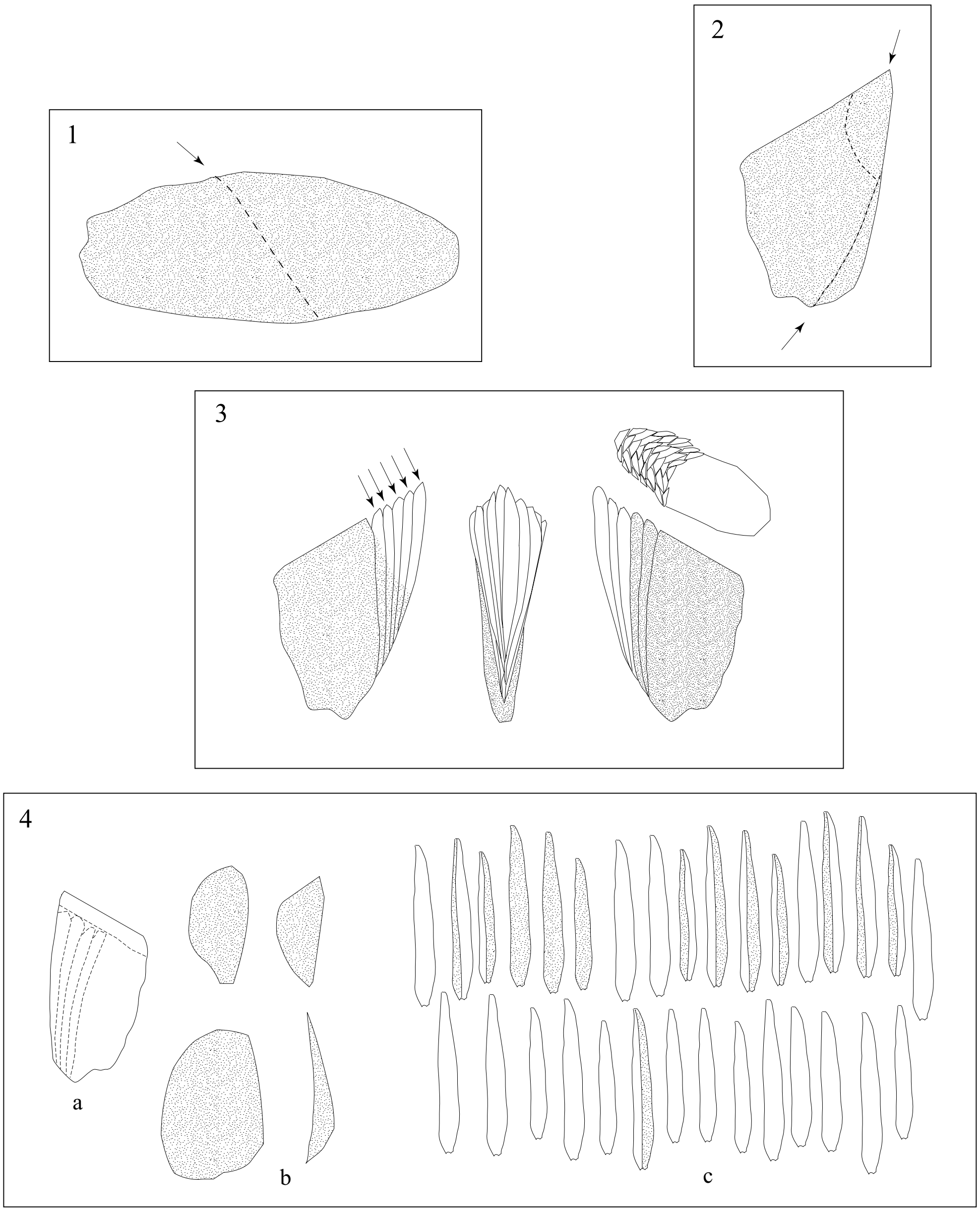

Fig. 11.2 Schematic of reduction sequence at Boker A: 1 – nodule split into two potential cores; 2 – removal of cortical flakes to prepare the blade removal surface, the striking platform already formed in step #1; 3 – unidirectional series blade reduction, note narrowness of core face, distally converging removals; 4 – end products of the first stages of core reduction (without any rejuvenation), a – core with potential for tablet rejuvenation and further blade removals; b – cortical flakes from step # 2; c – cortical and non-cortical blades.

Since the lithics cannot then be easily sorted into discrete groups based on the visible properties of the flint, the refitting of the material is fairly difficult and time consuming.

Core Reduction at Boker A

The reduction strategy employed by the Early Ahmarian inhabitants of Boker A, as evidenced by the refit cores, is simple, consistent, and predictable. It began with bringing unworked raw material into the site, which then underwent limited core configuration, serial blade production, followed by a short stage of core rejuvenation when warranted, more blade production, tool production and use, and ending with core and tool discard (Fig. 11.2). In other words, the lithic assemblage of Boker A appears to be representative of the entire *chaîne opératoire*.

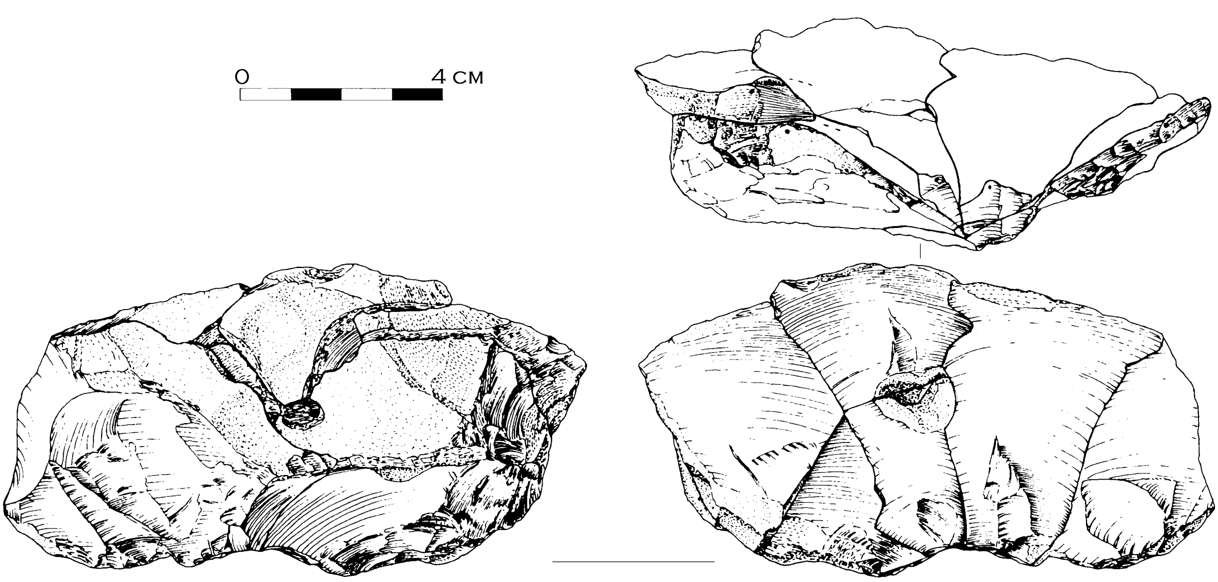

Fig. 11.3 Boker A: refitted core preparation sequence; note salient bulbs of percussion (drawn by V. Usik).

Preforming

Keeled, disc-shaped pieces of raw material with a natural crest appear to have been the preferred configuration for use as cores. In those cases where the raw material was in the form of slabs, or this crested shape was otherwise not the natural form, then the nodule would undergo a stage of preforming to contrive this configuration.

The preforming of the nodule was geared towards the production of a narrow sided blade core. In most instances, this could be obtained through simply splitting the cobble or lamina of raw material. More elaborate preforming sometimes occurred through the removal of large cortical flakes parallel, perpendicular, or transverse to what would become the axis of percussion. The flakes of this stage display large cortical or unfaceted platforms, with no abrasion, large salient bulbs of percussion, and are indicative of detachment by hard hammer percussion (Fig. 11.3). Decortication appears to have been limited to cleaning only the face from which blades would be detached and, perpendicular to this, what would become the core's striking platform. The common occurrence of blades with a cortical lateral edge that were detached during the process of blade reduction suggests, however, that the removal of cortical pieces during the nodule configuration stage was related more to the shaping of the nodule, than to an intent to form a completely non-cortical flaking surface.

The initial core platform was shaped by the removal of a single massive flake, obliquely to the axis of the blade flaking surface, giving the core platform an acute exterior platform angle approaching 70 degrees. All blade production at Boker A is from single platform cores.

Blade Production

Blade production proper commenced using a long natural ridge on the core face, or, in its absence, a simple *lame à crête*. An average of three to four blades were removed serially from the core face, with the last blades at the core face edge removed at such an angle as to ensure frontal convexity for the next series of blade removals. These flaking angles also ensured that the distal end of the core face remained pointed. As a result, the blades at Boker A display a suite of invariable morphological attributes: they are parallel sided, very elongated (the mean L/W ratio = 4.4), distally feathering to a point, in profile are flat to slightly medially incurvate (and not twisted), and have converging unidirectional scar patterns (Fig. 11.4).

Abrasion of the intersection between the flaking surface and core platform was used habitually before blade detachment to remove overhang and gain a better purchase for the percussor. Blade platforms are small, unfaceted, with diffuse bulbs of percussion, and usually lipped, indicating that once blade reduction began, the percussor was changed from a hard hammer to a soft one.

Core Rejuvenation

Major rejuvenation of the core's striking platform was carried out by the removal of a core tablet. Core tablets were invariably struck perpendicular to the flaking surface, parallel to the old platform, and are between 0.5 and 0.75 cm thick. In most cases (86%), the point of percussion for the core tablet is on the blade flaking surface, so that it carries the upper, or proximal, portions of blade scar facets on its striking platform (Fig. 11.5b-d). Only in rare

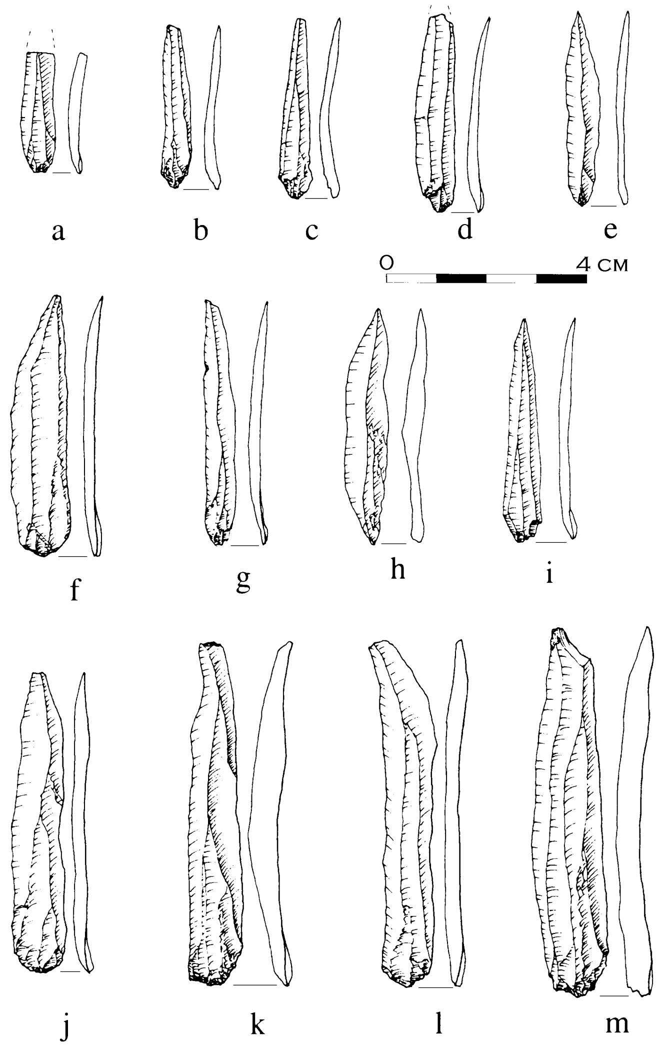

Fig. 11.4 Boker A: bladelet and blade debitage.

instances are tablets struck from the side (90º to the original platform) or back (180º to the original platform) of the core. Hard hammer percussion appears to have been used at this stage, based on the large salient bulbs on all the core tablets, and bulb negatives on the cores. While in some cases, cores were abandoned before undergoing a re-juvenation stage, it is not uncommon for cores to have three or more core tablet removals (Fig. 11.5d).

Occasionally, lateral core convexities were restored by the removal of cortical flakes from the sides of the core at the striking platform or transverse to the flaking surface. Subsequent blade removals along these edges would then display partial *lame à crête* scar patterns (Fig. 11.6g-i). Such reshaping of the core sides was usually not necessary if the series blade production was successful (as it constantly maintained convexities), except in those cases where the natural nodule shape was irregular or expanding. Wide, plunging blades were struck off the core face after a long blade removal series to get rid of the numerous *arrises* that might have interfered with the shape of the distal blade tip and to restore the keel of the core face (Fig. 11.6a-b). This type of core cleaning element sometimes displays a short cresting scar pattern towards its distal end, indicative of minor reshaping of the distal end of the core (Fig. 11.6c-e).

Abandonment

Based on final core morphology, flaking surface con-vexities, size, and platform angles, cores do not appear to have been particularly exhausted when discarded, although this is a subjective assessment. Abandonment seems related to flaws in the raw material, hinging on the core face, or the loss of the nose-shaped striking platform and keel of the flaking surface. Since reduction was along the narrow edge of the core, core volume was reduced along the thickness axis; that is, from the front of the flaking surface, backwards. In most cases, then, the core

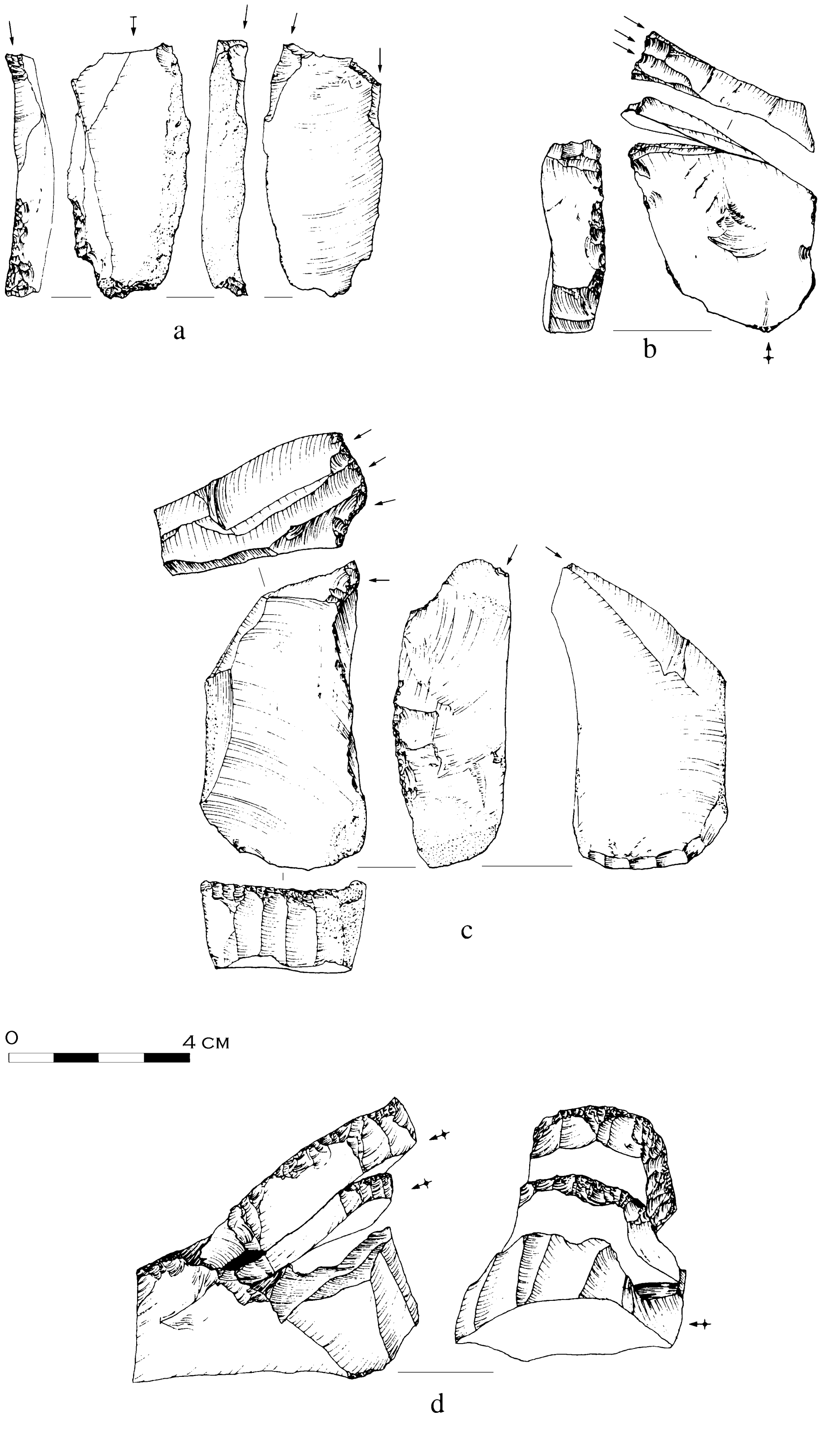

Fig. 11.5 Boker A: a – burin on partially cortical thick blade fragment, conjoined in the core depicted in Fig. 11.7; b – burin on core tablet, dorsal view shows one refitted spall; c – burin on core tablet, refits directly onto preparation sequence depicted in Fig. 11.3; d – series of refit core tablets, the first tablet is depicted in b.

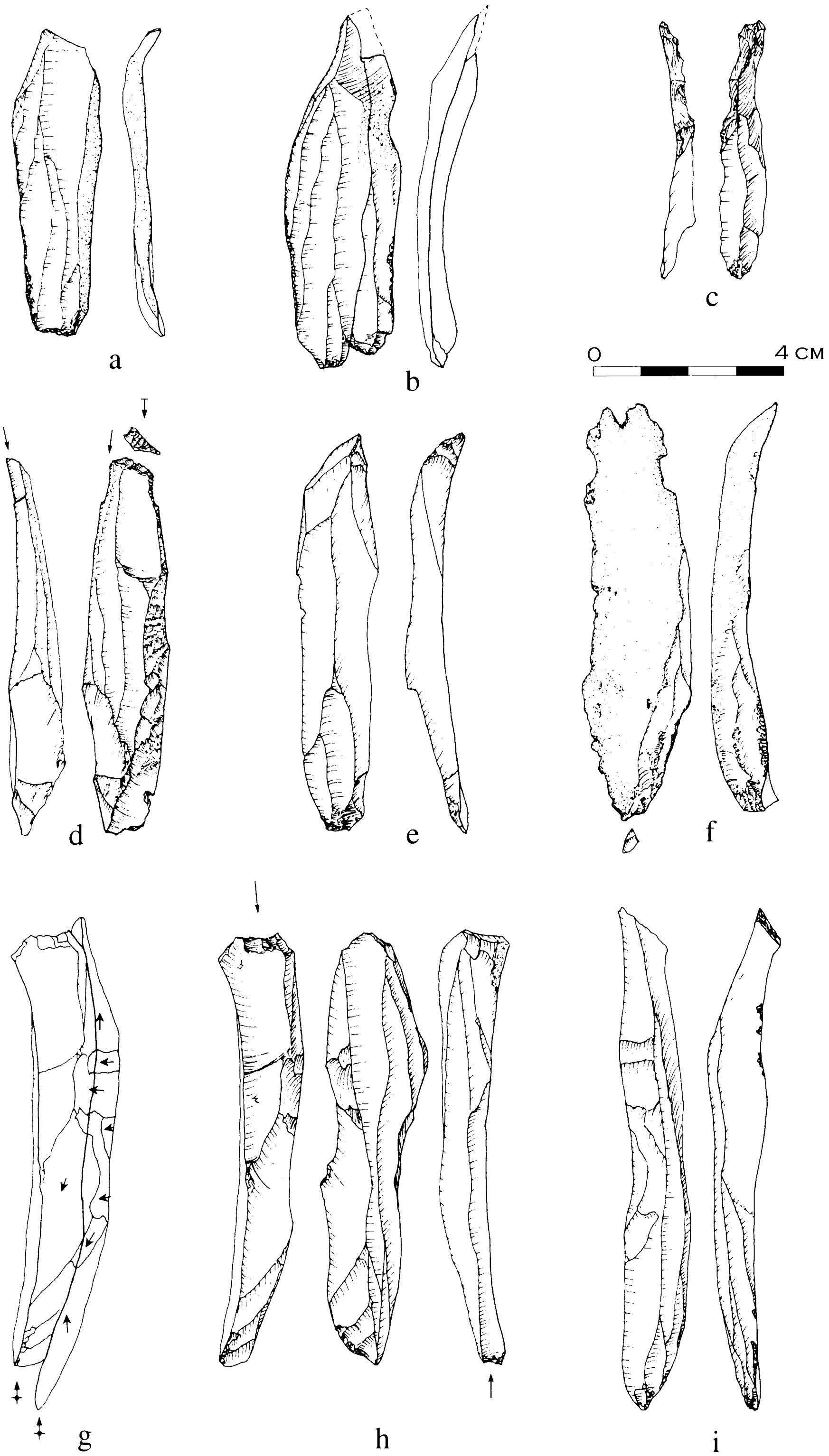

Fig. 11.6 Boker A: a – retouched partially cortical and overpassed blade; b – two retouched overpassed blades; c – distally crested bladelet; d – burin on retouched truncation made on thick blade with distal cresting; e – distally crested blade; f – retouched primary blade; g – refitting of h and i showing remnants of transversally removed cleaning flakes; h – burin on retouched truncation; I – retouched and truncated blade.

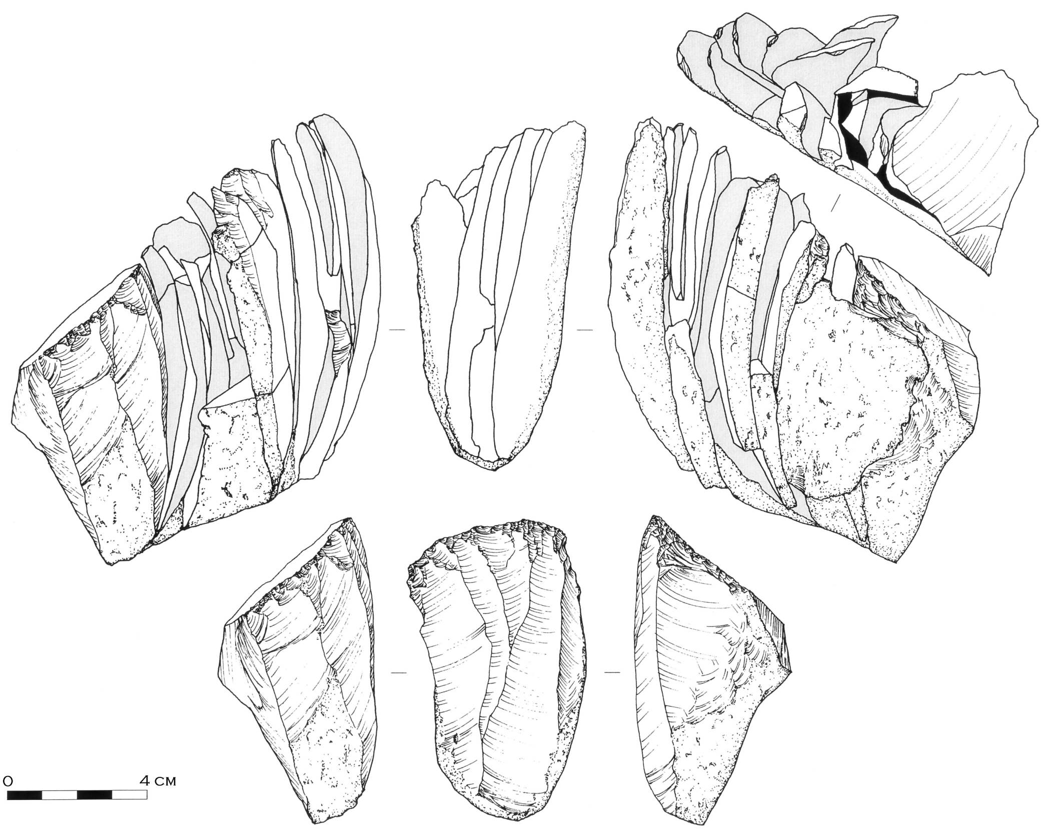

Fig. 11.7 Refitted core at Boker A (ventral surfaces shaded grey) and the core as abandoned.

flaking surface was long enough and the angles acute enough for further reduction, but only through a substantial reshaping that does not seem to be part of the Boker A repertoire.

Discussion of Refitting Results

Although the refitting project at Boker A is far from complete, a clear and consistent pattern of reduction seems evident. Aside from the numerous conjoins of individual broken artefacts and small-scale refits of just a few pieces, 27 major reconstructions directly implicate the entire core reduction sequence employed by the site's inhabitants. These range from mostly complete examples from the initial stage to the last, as in Fig. 11.7, to refits containing nearly all elements except the core itself, to large clusters of refit blades and core cleaning elements where the remaining pieces can still be inferred. As such, they represent just over 25% of the 98 cores recovered during excavations. The uniformity in reduction stages displayed in these major reconstructions, furthermore, is echoed in the more limited conjoins (of only initial nodule removals or clusters of 10 or fewer pieces) as well as the technological characteristics of individual artefacts in the assemblage.

The stage of nodule preforming is undoubtedly the most complicated and time-consuming step in blade production. It is also the most important, for without proper configuration, blades will vary in size and shape, platforms might be crushed, blades might fail, either by hinging, overpassing, or terminating abruptly, and the knapper must spend further time and energy tackling these problems. A well-prepared core, or a felicitously shaped nodule, as was most often used at Boker A, is suitable for producing numerous series of blades that are standardized in shape and size, quickly, and with little effort. As the blades themselves maintain core shape during their removal, extensive core reshaping is unnecessary.

Seven modes of preparatory patterns were originally described for Boker A (following the terminology proposed by Ferring 1976), particularizing core back, lateral, and frontal modifications (Jones *et al.* 1983: Table 9–6). The lithic refits, however, suggest that such detailed description unnecessarily complicates the issue: a specific core form was sought, and any preparation undertaken to arrive at this form was dependent on a particular nodule's natural configuration, rather than a culture-specific or knapper-specific mode of preparation. That is, there is a fundamental conceptual difference between the strategies used during the core preparation stage and the blade production stage. While the suite of technical manoeuvres used during blade production is patterned and redundant,

producing blanks that share identical morphologies on all cores, the strategy for the preparation of the core is *ad hoc*, core specific, and does not produce blanks of particular and repeated morphologies.

Refits also demonstrated that what was taken as evidence for initial core configuration, based on the scar patterns on the abandoned cores and cortical flakes, actually occurred somewhat later in the core's life. Preparatory flakes to change the shape of the nodule are easily confounded with flakes struck off only to remove cortex. One specific raw material type, a dark chocolate brown flint, was covered by very friable, chalky cortex, often exceeding 10 mm in thickness. In all cases where this raw material was used, extensive preforming occurred on most sides of the nodule to remove this cortex (Fig. 11.3). More than half of the cores at Boker A required neither of these two types of removals of the core configuration stage because they were already optimally shaped, and, in many cases, had only a thin, weathered cortical rind that did not hamper the reduction process.

Typologically, the abandoned cores at Boker A include a few examples of flake cores and opposed platform cores. But, while bi-directional core strategies have been noted at other Early Ahmarian sites, it was not a mode utilized at Boker A. The opposed or crossed scar patterns on some of the cores are, in fact, the result of attempts to improve core face convexities and thin the distal end after core reduction was already underway. This is borne out by the analyses of scar patterns on debitage (Ferring 1980; Jones *et al.* 1983) that show an overwhelming preponderance of unidirectional facets. Ferring (1980:115) also noted that pieces with bi-directional scar patterns were considerably larger in overall size than those displaying unidirectional scar patterns, indicative of their role as core maintenance products.

The sequence of steps outlined above – choosing a narrow sided nodule, core preforming when necessary, serial blade production, core platform rejuvenation through tablets, the use of hard hammer percussion for core cleaning and rejuvenation pieces, but soft hammer percussion for blade removal – was consistently employed, and in fact, the same sequence was used on two core types: blade cores and bladelet cores. The difference between these two lies *only* in their original size. Although raw material was immediately available and came in a number of shapes and sizes, at times, very small nodules were specifically chosen for reduction. Since the metric dimensions for abandoned cores and blades/bladelets (Fig. 11.8) display a unimodal curve, the purposeful use of bladelet cores is masked. Refitting was able to demonstrate that these were not always simply the larger cores worked down, as originally hypothesized (Jones *et al.* 1983), but were small to begin with and would only have produced bladelet-sized debitage.

The blade versus bladelet distinction is an analytical tool only, of course, but it is a useful means of lithic description despite its methodological problems (*e.g.*, Hassan 1972; Rozoy 1968). The Boker A assemblage contains: core conjoins that produced only bladelets (9); and conjoins that produced only blades (13). Yet it also contains conjoins whose first blades were in the 60–70 mm length range (3), as well as blade cores that were worked down to bladelet-producing cores at the end of their use-lives (2). That is, there is no dimensional bimodality in the reduction sequence. To verify whether the conjoined cores were representative of the whole assemblage in regard to initial core sizes and blade/bladelet sizes, metric observations of length, width, and thickness were made on a random sample of complete blades and bladelets in the assemblage (including retouched and unretouched pieces, cortical and non-cortical pieces). Both length (ranging between 20 and 115 mm, with a mean of 52 mm) and width (ranging between 5 and 30 mm, with a mean of 12 mm) are unimodally distributed. There are a disproportionate number of small pieces, however, with length, width, and thickness all skewed to the left. This is even more pronounced when debitage and tools are separated (Fig. 11.8b, c): despite having a large pool of fine bladelets, tools tend to be made on the slightly larger pieces. These findings were unexpected as the inhabitants of Boker A were under no raw material constraints – either in size or quantity – that might lead them to conserve material and because there is not a clear preference for bladelet-sized blanks used in tool manufacture.

As noted in the original analysis of the Boker A material (Jones *et al.* 1983), the most distinctive tools in the assemblage, such as el-Wad points, inversely retouched points, and backed points, display great variation in length, ranging from 40 to 65 mm. Otherwise, they are quite standardized in shape, width, thickness, and symmetry. The mean length of the el-Wad points, in fact, falls at 50 mm, leading Jones *et al.* (1983:299) to conclude that the distinction between blades and bladelets was essentially arbitrary, at least in this particular case, as the inhabitants of Boker A seemed to be more concerned with the overall shape of the blank for tool production.

The evidence that we now have from refits for the intentional use of small nodules producing blades smaller than 50 mm in length and 12 mm in width does not necessarily cast those original conclusions about desirable blade size in doubt. Instead, the appearance of bladelet cores indicates that the prehistoric inhabitants wanted small blades and it was easier just to pick up a smaller nodule than hope that the big blade-producing cores would eventually be worked down enough to produce bladelets. On the other hand, they also had need of the larger pieces that a big nodule would produce and so did not preferentially select only small nodules for reduction.

Blank Choice and Tool Production at Boker A

The Boker A Ahmarian assemblage contains a very high percentage of fine, very elongated blades/bladelets (62%

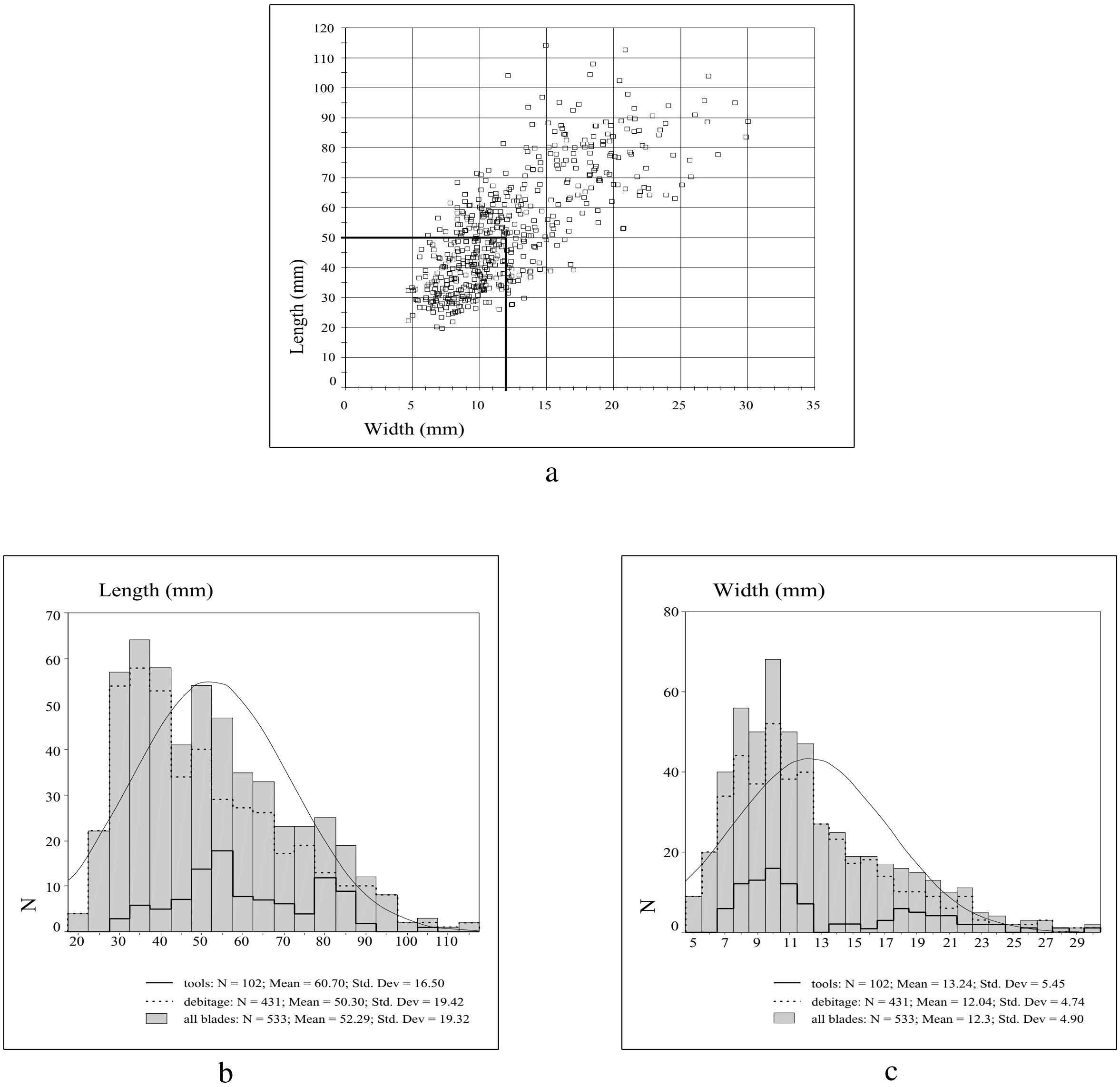

Fig. 11.8 Boker A: length and width dimensions for blades (includes interior, exterior, retouched and unretouched pieces): a – length/width scatter plot for all blades, heavier lines indicate maximum bladelet dimensions; b-c – length and width histograms for all blades, with separate tool and unretouched histograms superimposed, normal curves are for combined blades.

of non-chip debitage) and it is obvious that their production was an important part of site activities. Concomitantly, tools made on blades, or that are blade-proportioned, account for nearly 80% of the tool kit (Jones *et al.* 1983). The tool inventory is fairly limited and is dominated by point tools (32%): mostly el-Wad points, inversely retouched points, and backed points, made on untwisted blades and bladelets (Fig. 11.9). Simple retouched pieces are the second most important tool class at about 25% (Fig. 11.6a, b, f, i), followed by burins (16%) (Fig. 11.6d, h; Fig. 11.5a-c), both made on a variety of blank types. Backed pieces, including backed points, account for nearly 10% of the toolkit and are preferentially made on blade rather than bladelet proportioned pieces (Fig. 11.9o-p). There are no carinated pieces and end-scrapers are quite rare (2%), limited to simple forms on blades or primary elements (Jones *et al.* 1983: Table 9–5).

Given the very high numbers of interior blades/bladelets in Ahmarian sites and the modification of these into distinctive tool forms (el-Wad points, and other retouched or backed blade/bladelets), it is often assumed that the makers wanted to produce a single type of end product: a non-cortical distally pointed blade (*e.g.*, Coinman 1998a:44; Ferring 1988:334 and 348). The knapper's choice of a nodule that is naturally keeled with

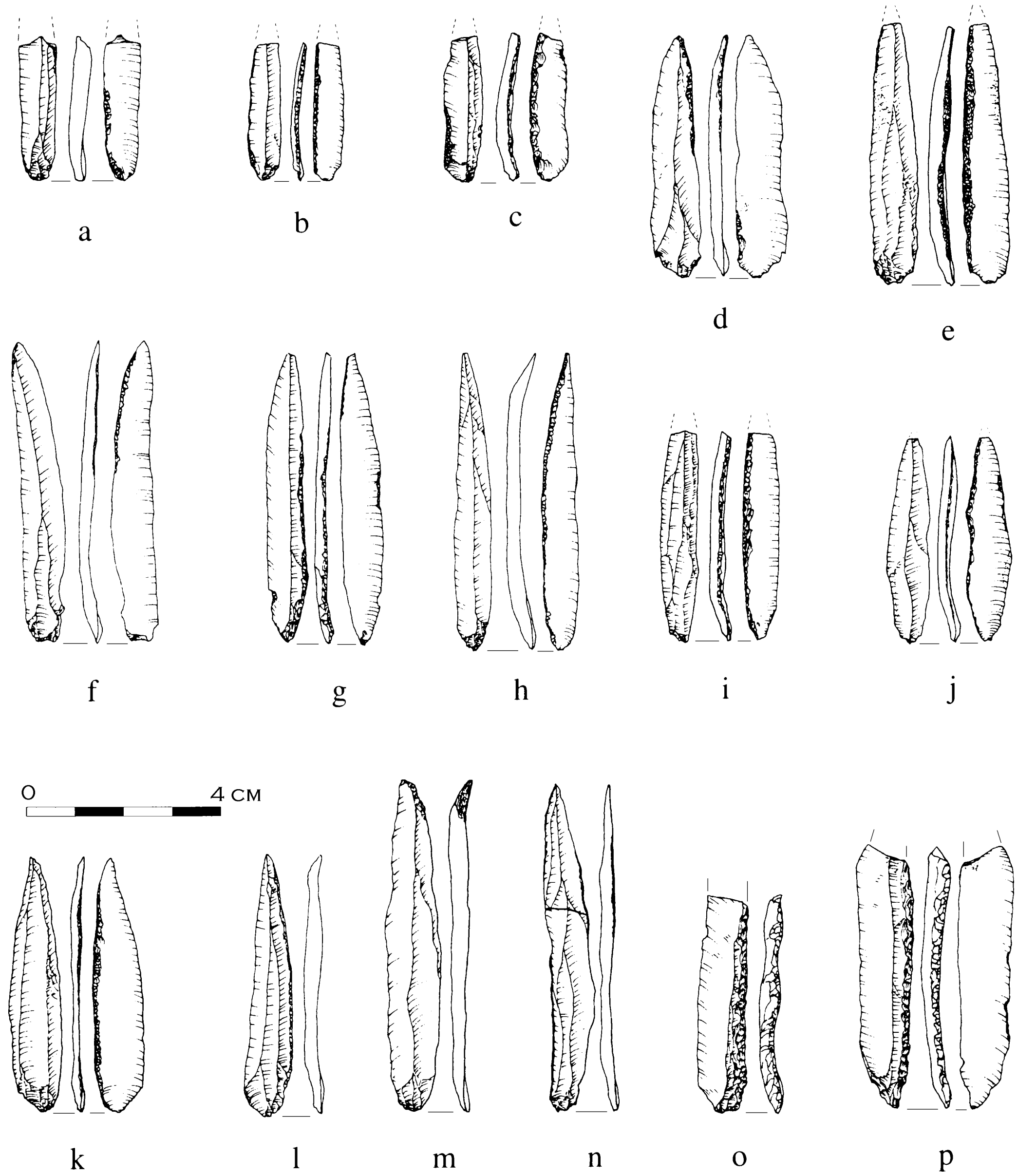

Fig. 11.9 Boker A: a – inversely retouched bladelet; b-g – alternately retouched el-Wad points; h-k – inversely retouched points; l-n – obversely retouched el-Wad points; o – backed bladelet; p – backed blade.

narrow sides and that required little to no pre-shaping, however, resulted in a large proportion of blades with lateral, and frequently, distal, cortex. In the attribute analyses previously conducted on the Boker A assemblage (Ferring 1980; Jones *et al.* 1983), cortical debitage was typed as a preparatory product and, therefore, not the intended or desired end product. Fig. 11.7 shows a refitted core where nearly half of the blades removed had some cortex present. It would have been a simple matter for the knapper to remove a few decortication flakes at the beginning of this core's reduction if the objective was only to produce non-cortical interior products. Yet, it appears that the knapper neither wanted to go through the trouble of decortication nor particularly cared if cortex was present.

Although intimated by others, Ferring (1980, 1988) has proposed that Early Ahmarian core reduction was geared towards a single intentional product: a non-cortical blade/bladelet blank conforming to 'critical morphologies' for its use as an el-Wad point or backed bladelet, for example. His contradistinctions between blanks displaying critical morphologies versus those whose primary purpose was core related, are a useful way of looking at a lithic assemblage and highlight the differences between core preparation/maintenance elements and serial blade production elements. In his terms, a choice is made

before reduction begins to set up the core to produce at least one more or less specific blank type, such as blades or Levallois points. In our case, it appears the knappers desired a specific narrow-faced and keeled core shape, and any detachments to obtain this shape are only by-products of reduction. Thus, core tablets, crested blades, overpassed cleaning blades, primary flakes and large blades, whether detached at the outset or in the midst of the reduction process, serve a particular core configuration or maintenance purpose and *must* be generated in order for the core to undergo a serial blade/bladelet production (*e.g.*, Tixier 1984). While fully cognisant of the use of these reduction by-products (flakes, cortical blades, core trimming elements, *etc.*) for tool manufacture, Ferring considered these simply an expedient use of already available debitage, since their primary purpose was core preparation/maintenance and since they do not display any critical morphologies.

One cannot possibly hope to delineate the desires of an Early Ahmarian flint knapper and claim that the cortical products, interior cleaning elements such as plunging blades, and other types of core trimming elements were equally predetermined. Their lack of standardization in nearly all metrical and morphological aspects indicates that their removal was on an *ad hoc* basis dependant on nodule shape and how the reduction, at that point in time, was progressing. However, the dichotomy proposed by Ferring is problematic in several respects. If the intentional products must be non-cortical interior blades, then it would have been more efficient for the knapper to prolong the initial decortication/configuration stage. This would result in more non-cortical blade/bladelet blanks, rather than the production of such a large number of thick cortical blades during serial blade reduction as is the case at Boker A. Given the diversity and proximity of flint resources in the site catchment area, one would expect more frequent use of smaller, narrower cores that would have produced shorter/narrower blades, rather than the massive blades with and without cortex so many of the large cores begot. The fact that we now have evidence for the deliberate use of small cores, producing bladelets in the length range of 50 mm or less, suggests that the flint-knappers were not adverse to using small cores, but did have something definite in mind when they reduced the much larger cores.

Finally, if one thinks of the 'intentional' core reduction product as the one which is most often utilized as a tool blank, then it is the larger, thicker blades that were desired: they are most prevalent blanks in the tool assemblage (46%), while bladelets only account for 32% of tool blanks (Jones *et al.* 1983: Table 9–5). Despite their status in the core reduction process, however, the use of flakes, core trimming elements, and other core reduction by-products is not at all insubstantial, comprising 22% of the tool assemblage. As for the percentages of blanks within each debitage category transformed into tools, proportionally, the pieces normally considered reduction by-products, actually show a much higher percentage of class utilization than do the blades (Jones *et al.* 1983:Table 9–3). That is, 36% of the available flake and core trimming elements were transformed into tools, versus only 10% of the available blade/bladelet blanks. The large size and robustness of the flake and core trimming pieces make them amenable for use as blanks for heavy duty tools, such as scrapers, burins, denticulates, and notches, as well as for their use as expedient tool types such as the marginally retouched pieces (Figs. 11.5 and 11.6).

Site Patterning

The single *in situ* living floor of Boker A is only one to two artefacts thick, or about 4 cm, but is densely concentrated. The excavations were fairly limited in extent, due to erosion along the eastern side of the terrace in which the site is located, with an exposure of 24.5 m². Within this, the artefacts were mostly concentrated in an area of about 13 m² and indicate that the site was only briefly occupied by a small group of persons (Marks 1981a). A single feature, an extensive firepit, was also located within this small area. With the exception of a tight clustering of el-Wad points, all found within 2 m of each other, no specific activity areas appear evident at the site: debitage, cores, and tools are distributed throughout the site exposure (Fig. 11.10). The plotting of provenience of individual pieces from refit clusters onto the site grid likewise shows no particular activity specific areas for core reduction or tool production.

The erosion of the terrace remnant along one side of the excavated area of the site, coupled with the extremely homogenous techno-typological characteristics of the Boker A assemblage and the el-Wad point cluster, have led to the suggestion that the assemblage may represent only a portion of the site activities (Kerry and Henry this volume; Marks and Ferring 1988). The refitting program, however, adequately disproves this since most refits show the full suite of core reduction and tool manufacture that the inhabitants carried out during their brief stay at the site. Furthermore, there is nothing in the available lithic assemblage remotely suggesting that the unexcavated squares at Boker A might contain high numbers of non-cortical flakes, wide blades, evidence for carination, or a wider variety of core types. That is, unlike a number of other assemblages whose attribution has been called into question or changed based on sampling methods (*e.g.*, Kerry and Henry this volume), Boker A cannot be confused with the Levantine Aurignacian, or even the Later Ahmarian since it so patently conforms to the definitions of the Ahmarian initially put forth by Gilead (1981a) and Marks (1981a).

Without having a near total sample of refit blades and bladelets, it would be premature, if not impossible, to claim that the inhabitants carried blade/bladelet-proportioned tools and blanks away with them when they left Boker A. On the other hand, there is a conspicuous

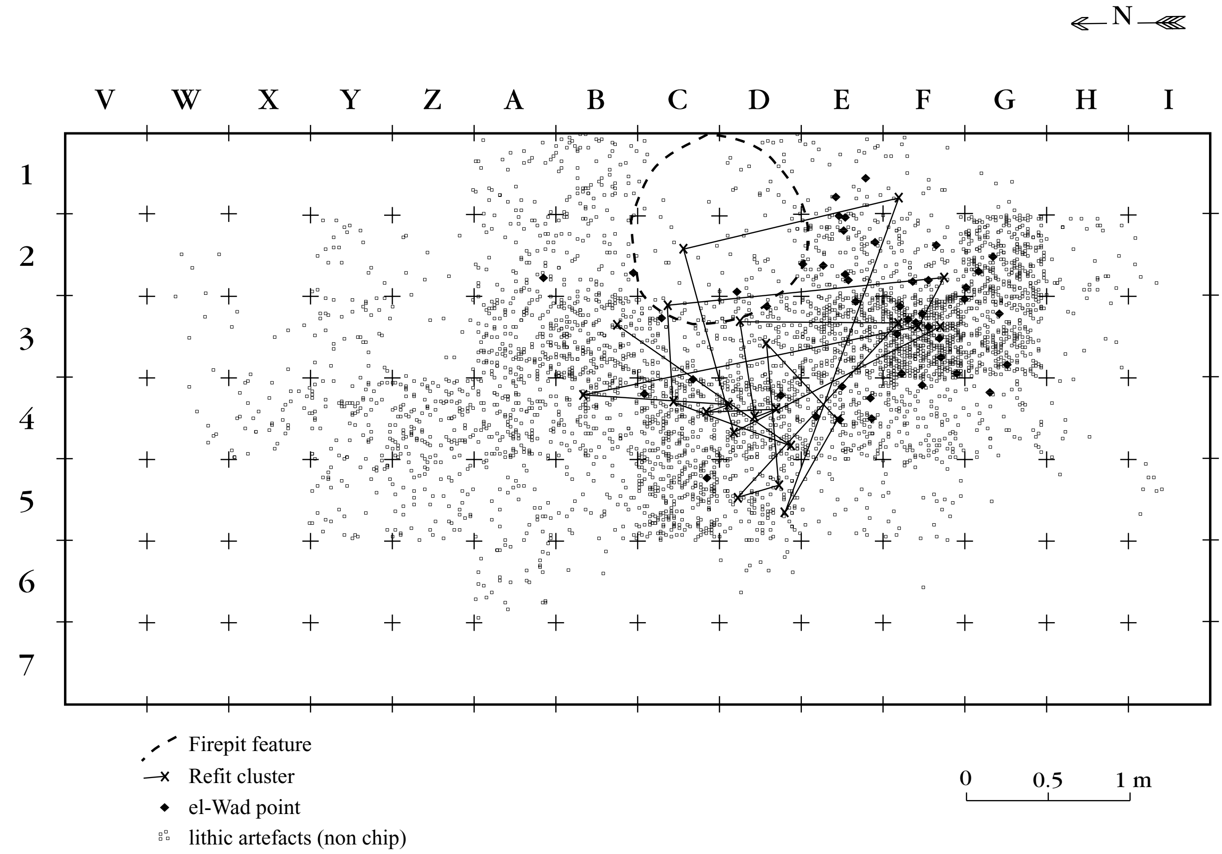

Fig. 11.10 Spatial distribution at Boker A of all artefacts (excluding chips and chunks), el-Wad points, and the core conjoin depicted in Fig. 11.7.

absence of certain of the larger core trimming elements and cortical flakes that ought to be in the assemblage, but are not. Their shape, size, and function may be easily guessed from their negatives on the core conjoins. Such lithic exportation appears to have occurred only infrequently; for the most part the entire reduction sequence – from bringing unworked nodules into the site until they are discarded as cores – is represented at Boker A.

Discussion

Excepting the use of bladelet cores, the reduction strategy outlined here for Boker A has a long precedent in the Levant. It is much the same as one of the three methods of core reduction described for the nearby site (located just across the wadi) of Boker Tachtit Level 4. Option 1 in Boker Tachtit Level 4 (Volkman 1983:170–174) differs from the Boker A strategy only in two aspects. At Boker Tachtit hard hammer percussion was used exclusively, and instead of a core tablet technique, fine faceting was used for platform rejuvenation (core tablets were habitually used in the other reduction options at Boker Tachtit Level 4, however.) There is a typological break at the appearance of the Early Ahmarian from the antecedent Levantine Mousterian and terminal Middle Palaeolithic/initial Upper Palaeolithic blade industries, but technologically, there is no break. The unidirectional narrow sided blade core technique which saw incipient and sporadic use in the Early Levantine Mousterian (Monigal 2001) and which was one of the technological options in Boker Tachtit Level 4, has only been perfected in Boker A in minor details and used exclusively.

Given the differences in site size, duration of occupation, and distance to raw material resources among the southern Levantine Early Ahmarian sites in the Negev (Ferring 1980; Marks 1976a, 1977a, 1983a; Marks and Ferring 1988), Sinai (Bar-Yosef and Belfer 1977; Becker this volume; Gilead and Bar-Yosef 1993; Goring-Morris 1995a; Phillips 1987a, 1988, 1991), Wadi Hasa (Coinman this volume with references), and Jebel Qalkha (Coinman and Henry 1995), it is unreasonable to expect direct correlates of the very specific reduction sequence and tool composition at Boker A to these other sites. While an in-depth comparison of all Ahmarian sites is outside the scope of this paper, a few general remarks can be made about the sites thought to be closely contemporary and located within the same geographical area as Boker A.

Some parallels seem to exist, both in typology and

technology, between Boker A and the Lagaman sites of Gebel Maghara, which are dated to *ca*. 32,000 years ago (Bar-Yosef and Belfer 1977). El-Wad points and retouched blades and bladelets dominate most of the Lagaman assemblages, while burins, endscrapers, and backed pieces tend to be present in only minor amounts. Unidirectional core reduction likewise predominates in the Lagaman sites, with a high incidence of the narrow sided keeled cores seen at Boker A (Bar-Yosef and Belfer 1977: Figs. 18, 20, 25, 29, 34). Blades and bladelets make up the bulk of debitage products, and appear to be equally elongated and as finely made as those at Boker A. Heavier tools such as endscrapers, burins, and *pièces esquillées* appear to be preferentially made on thick, often cortical, flakes and core trimming elements.

A detailed study of the Lagaman sites (Gilead 1981b) concluded that the high proportion of bladelets and small size of the abandoned cores was a response to raw material scarcity; blades were produced at the beginning of the core reduction sequence, while bladelets were produced as the core was progressively worked down. There is, however, clear bimodality evident in the blade/bladelet blank sizes chosen for tool manufacture at the Lagaman sites (Bar-Yosef and Belfer 1977:45), suggesting intentional choice of bladelet cores. The presence of carinated scrapers and burins in some of the Lagaman sites should be noted, for these may be responsible for at least some of the bladelet production there.

A refitting project in progress for the Lagaman site of Nahal Nizzana XIII in the western Negev has indicated that a number of the technological trends present at Boker A were also used at that site (Davidzon 2002; Goring-Morris *et al*. 1998). These include systematic preparation and maintenance of narrow carinated cores to predetermine the shape and size of blade/bladelet blanks, which in turn required only minimal modification to be transformed into tools. Core rejuvenation procedures include the use of large overpassed blades (ridge blades) for convexity of the flaking surface, core tablets, and the methodical maintenance of the striking platform angle (Goring-Morris personal communication). Also noted (Goring-Morris *et al*. 1998) was a consistent use of core reduction by-products, such as decortication elements, striking platform preparation pieces, and core trimming elements, as blanks for medium-sized tools.

Ein Qadis IV, on the Negev/Sinai border likewise displays many of the technological features seen at Nahal Nizzana XIII (Goring-Morris 1995a). Elongated blades and bladelets were produced from unidirectional, narrow sided cores, made on locally available raw material. Extensive preparation of the nodule predetermined the shape and dimensions of these, while the by-products of this preparation were made into massive endscrapers, burins, and other tools (Goring-Morris 1995a). Ein Qadis IV differs in many respects typologically from Boker A, with much higher percentages of endscrapers and backed blades, and much lower percentages of burins. El-Wad points and retouched blades and bladelets are commensurate however.

Abu Noshra I and II, in southern Sinai, are located between 15 and 60 km from various flint sources and are dated to about 32,000 years ago (Phillips 1987a, 1988, 1991). Abu Noshra I has been interpreted as a kill site, while the larger Abu Noshra II has been interpreted as a base camp (Phillips 1988; and see Becker this volume). Although considered roughly contemporary and part of the same settlement system, the two sites differ typologically, probably due to their functional differences. In a general sense, both Abu Noshra sites have the same typological components seen at Boker A, with a dominance of point tools (based on illustrations in Phillips 1987a and 1988, since this tool type was not recognized in the published typology) and retouched blades/bladelets, and relatively low proportions of endscrapers, burins, notches and denticulates. Both Abu Noshra sites, however, have higher incidences of backed tools (Phillips 1988). In technological aspects, the three sites display many similarities: refitting at Abu Noshra I and II indicates a preferential choice of nodules that are narrow sided and ideal for blade manufacture, and which did not require extensive decortication (Phillips 1988, 1991: Figs. 5 and 7). Soft hammer percussion was used for the blade production stage, while hard hammer was used for core configuration and decortication (Phillips 1988). Finally, many of the larger tools appear to be made on cortical blades, crested blades, and other core trimming elements (Phillips 1988: Figs. 5–7, 9). The Abu Noshra sites are closely analogous to Boker A in their site setting and lithic reduction strategy, but it is unclear how many bladelets there are in the assemblage, the percentage of these transformed into tools, and whether there was a deliberate use of bladelet cores by the inhabitants.

The Qadesh Barnea (Gilead and Bar-Yosef 1993) sites of northeastern Sinai are workshop sites located close to abundant raw material, where at least most of the lithic processing suite was carried out. Although there is some typological variability among the six sites, as a rule, they have low endscraper and burin indices and are dominated by blade tools. They differ typologically from Boker A and the Lagaman sites, however, by lower incidences of el-Wad points and high incidences of backed tools, as well as by significant percentages of notches and denticulates. Refitted cores at QB 601 indicate that reduction was geared towards serial blade removal with a core tablet technique for platform rejuvenation. The cores at these sites however, include bi-directional and unidirectional pyramidal types and they tend to be big and to have produced blades, rather than bladelets. The large size of blades, as compared to the Lagaman sites, for example, and the near lack of bladelet tools in the Qadesh Barnea sites has been ascribed to the abundant local flint resources, where conservation of raw material was unnecessary (Gilead and Bar-Yosef 1993).

Early Ahmarian sites in the eastern Wadi Hasa, in-

cluding Tor Sadaf, Thalab al-Buhayra, and EHLPP 1 (Coinman this volume; Fox this volume), vary in occupation duration and intensity, but are all located close to raw material sources. Although still in the preliminary stages of analysis, they generally appear to be similar in core reduction strategies to Boker A, with the frequent use of thin, narrow sided cores where serial blade reduction occurred along the narrow edge (Coinman personal communication). Cores of this type have relatively little preparation before reduction commenced, and core tablet or platform blade techniques were used for platform rejuvenation. As at Boker A, larger tools such as burins and endscrapers are frequently made on core reduction by-products, such as cortical flakes and core tablets (Coinman 1997b). These sites are likewise similar typologically to Boker A, with high percentages of point tools and retouched blades and bladelets, along with low percentages of endscrapers and burins.

The limited toolkit diversity and predominance of blade/bladelet debitage has necessitated a rather generalized definition of the Early Ahmarian, which allows seemingly disparate assemblages to be grouped together. Site function undoubtedly plays a pivotal role in the variable toolkit and debitage class (blade, bladelet, and flake ratios) compositions of Early Ahmarian sites between the south, north, and southwestern Levant. Yet it is exceedingly difficult to evaluate since so many of the sites are small, ephemeral occupations, and especially in the south, lack any other materials besides flint artefacts. The absence of faunal remains, pollen, dateable materials, hearths and other structures; scanty use-wear analyses, as well as common site deflation, and generalized distribution of lithic artefacts precludes clearly identifying site use in the same manner as has been done for Abu Noshra I and II and which will undoubtedly be done for the Wadi Hasa sites.

In the absence of such functional data, as J. Tixier stressed nearly 13 years ago in closing the second Lyons colloquium on Levantine Prehistory (Bergman 1988b), step-by-step analyses of core reduction – rather than a simple tabular display of artefact classes – should be used to formulate the definitions of the Ahmarian and Levantine Aurignacian and to group sites accordingly. This process does not require core refitting, simply a better understanding of how to describe and report the technological attributes of an assemblage. Little in the Boker A refits has directly contradicted the earlier analyses of this site's lithic assemblage (Ferring 1980, 1988; Jones *et al.* 1983). Rather, it confirmed most of the conclusions drawn at that time based on attribute analyses alone.

Conclusion

Since its inception as an industrial entity (Gilead 1981a; Marks 1981a), the Levantine Early Ahmarian has been given a binary definition: on the technological side, it is characterized by a single core reduction strategy: a classic soft hammer blade technology. On the typological side it is characterized by a relatively homogenous and non-diverse toolkit with finely retouched blade/bladelet tools dominant, and minimal percentages of burins and end-scrapers. In these two aspects, it is contrasted with the later Upper Palaeolithic traditions, which have multiple reduction strategies and more diverse toolkits, including a range of tools made on flake blanks.

Early Ahmarian assemblages have been depicted as geared towards blade production from single or opposed platform cores whose 'intentional' products were non-cortical blades and bladelets. This blade to bladelet size distribution is thought to be purposeful, neither the result of accident, nor particularly due to core exhaustion. Larger and wider blade blanks produced at the beginning of the sequence were intended for certain types of tools, such as burins, endscrapers, and truncations. The smaller, narrower blades/bladelets produced later in the sequence, as the core was progressively worked down, were intended for pointed and backed tools (Gilead 1983; Marks and Ferring 1988; Coinman and Henry 1995).

In fact, contrary to expectations, the refitting at Boker A has amply demonstrated that there are two core sizes, blade cores and bladelet cores. They are essentially alike in configuration: the axis of reduction is along a narrow side, if the raw material does not already have a keeled and nosed configuration, it goes through a stage of decortication and shaping until it has one. Platform angles are always acute; platform regularization and soft hammer percussion during the blade/bladelet removal stage are used in both cases. The elongated blanks produced from both core sizes are similar in all morphological aspects, including degree of elongation, relative platform size, medial curvature, and scar patterns. Whether these are fully separate reduction strategies, therefore, is a matter of how a reduction strategy is defined. In the absence of clear tool blank choice patterning or any morphological differences between the blades and bladelets, it is, perhaps, more realistic to see them as part of a single strategy able to produce a pool of potential tool blanks that are homogenous in all aspects, *except for their relative lengths*.

Gilead has reprised at numerous junctures the futility of defining and differentiating Upper Palaeolithic and Epipalaeolithic cultures on the basis of such a simple criterion as blade versus bladelet production, since assemblages with a significant bladelet component first appeared in the early Upper Palaeolithic (*e.g.*, Gilead 1981b, 1984a, 1989). From a technological standpoint, however, there is probably good reason to continue this differentiation. Despite the evidence for the deliberate use of bladelet cores at Boker A, where raw material conservation was not a concern, Early Ahmarian blade/bladelet production is still dissimilar to the Late Ahmarian, with its separate and disparate core reduction strategies for diverse blank types; to the Aurignacian, whose bladelet production was mostly from carinated type

pieces; and to the Epipalaeolithic, whose mass production of bladelets from small pyramidal cores did not provide the large and variable blank sizes produced at Boker A.

The Boker A refits are an example of how graceful, straightforward, and efficient core reduction in the Early Ahmarian could be. The reduction strategy was efficient in the ease with which a large number of well made blades and bladelets, relatively standardized in shape were produced. But it is more important to note that the efficiency lies in how *all* components of the reduction strategy were used – flakes, cortical pieces, core tablets, and large blades – along with the narrow blades and bladelets. What is missing in these refits is also interesting – certain massive pieces, including core tablets and large cleaning flakes – that were carried away from the site. This further supports the hypothesis that the maker did not have a single ideal end product in mind while knapping, but was perfectly willing to use less than svelte core cleaning elements as well.

The site of Boker A represents only a brief occupation in an area close to permanent water, abundant raw material, and diverse floral and faunal communities. Unworked nodules in a specific shape, but in a variety of sizes, were imported into the site and fashioned into either blade or bladelet cores. The reduction method is simple and redundant, and all of its components were used for tool manufacture. While pointed blades are distinctive and obviously of importance, massive flakes and core trimming elements were also made into tools, and were frequently taken away from the site when the inhabitants continued on their way.

Acknowledgements

The Israel Antiquities Authority very generously loaned the Boker A material to Southern Methodist University for this refitting project. I am warmly grateful to Ofer Marder and Iris Yossifon of the IAA, for facilitating this loan and to John K. Williams for transporting the material. Vitale Usik (Archaeological Museum of the Institute of Zoology AN Ukraine) illustrated the reconstruction depicted in Fig. 11.3. This project arose from a suggestion by Anthony Marks, who arranged the loan, greatly aided with refitting, offered many good insights, and generally provided encouragement. Funding for the excavation of Boker A was made possible by grants from the National Science Foundation (BNS-76–81646, GS-42680) to A. E. Marks.

12. Spatial Patterning in the Upper Palaeolithic: A Perspective from the Abu Noshra Sites

Mark S. Becker

Introduction

Archaeologists have commonly noted discrete concentrations of lithic artefacts within prehistoric sites. Scholars often target these clusters for study because they potentially offer a means to isolate site activities, and hence behaviour, from spatial patterning in the archaeological record. The endeavour to identify behaviour from this patterning is also reflected by a variety of spatial methods, some which were more successful than others (*e.g.*, Carr 1984; Cahen *et al.* 1979; Hietala 1983a, b, 1984; Hodder and Orton 1976; Hodder 1977; Keeley 1991; Mellars 1996; Whallon 1973, 1984). Specifically, since the 1960–70's, a period when scholars became increasingly interested in using spatial analysis, a number of initial approaches have been discarded, as these analyses, especially quantitative spatial analyses, were rarely successful in identifying meaningful sets of tools or activity areas (Price 1991:303–304). However, with the later development of innovative methods, some researchers were successful in not only isolating activity areas, but also in finding correlations between some discrete clusters of artefacts and specific functional activities, most notably from sites in western Europe such as Meer II and Verberie (*e.g.*, Cahen *et al.* 1979; Cahen and Keeley 1980; Keeley 1991). In this paper I examine the possibility that discrete artefact clusters found in Upper Palaeolithic sites from southwest Asia could be the remains of functionally specific activity areas. In other words, can archaeologists assume that Upper Palaeolithic sites were generally segregated by spatial-functional organization? To examine this idea, I relied on a rigorous methodology that combines lithic use-wear analysis, lithic refitting, and spatial patterning analysis, which I refer to as the 'Meer Approach' (see Becker 1999; Cahen *et al.* 1979; Cahen and Keeley 1980). Although spatial studies, especially those that include lithic refitting are not new for the Levantine Upper Palaeolithic (*e.g.*, Hietala 1983a, b; Goring-Morris *et al.* 1998; Volkman 1983), the Meer Approach offers a relatively comprehensive means to sort out and examine additional aspects of prehistoric behaviour. In this case, my research results from two Upper Palaeolithic sites from the southern Levant show little correlation between any discrete clusters of artefacts and specific functional activities.

The Upper Palaeolithic Environment

For this study, I relied on research data from two early Upper Palaeolithic sites from southern Sinai (Fig. 12.1). Today, the Sinai Peninsula is located in an arid to a semi-arid zone, but environmental reconstructions indicate the climate was sometimes dramatically different in the past. Although further work is needed to clarify the palaeoclimatic history of the region, available data indicate that a fundamentally different environment existed in the highlands of southern Sinai during the Upper Palaeolithic. From *ca.* 45–22,000 bp, the Sinai Peninsula and the Negev had a moister climate than today (Gladfelter 1990; Goldberg 1986). A palaeoclimatic reconstruction of the highlands of southern Sinai suggests an oak/pistachio forest around 35,000 bp, based on data from faunal and floral remains, a situation similar to that in northern Israel during the last glacial (Gladfelter 1990; Phillips 1988). However, from *ca.* 22–14,500 bp, the western Negev and to some degree southern Sinai, appear to have been colder and drier (Goldberg 1994). Hence, the Upper Palaeolithic people who inhabited southern Sinai probably enjoyed a greater range of resources than that available in later time periods.

The Abu Noshra Sites: General Background

The Upper Palaeolithic sites in this study were part of an archaeological tradition known as the Early Ahmarian, and were recovered from Wadi Abu Noshra, a tributary of Wadi Feiran within the highlands of southern Sinai (Phillips 1987a, b, 1988, 1991; also see Fig. 12.1). The sites, Abu Noshra I and II yielded a series of radiocarbon dates ranging from 29,580+1610/-1340 to 38,924±1529 bp, not including extremely young or old dates (see Phillips 1994;

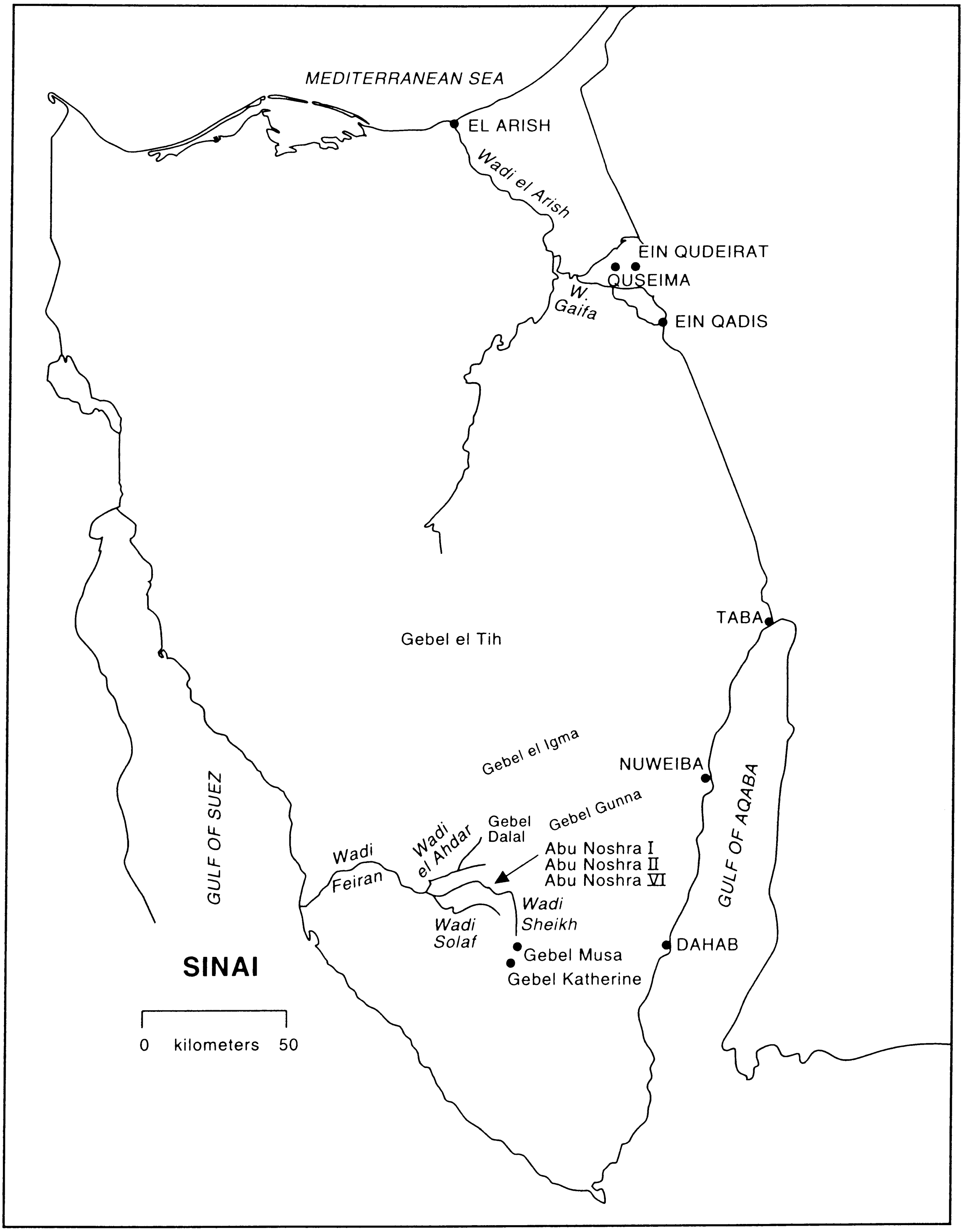

Fig. 12.1 Map of the Sinai peninsula showing location of sites.

and Appendix this volume). Abu Noshra I is stratigraphically higher than Abu Noshra II, and probably dates *ca*. 34/35,000 bp, while Abu Noshra II probably dates to *ca*. 36/37,000 bp. Abu Noshra I is also linked to another site, Abu Noshra VI, through a series of lithic refits which span 200 m, and these sites appear to be contemporaneous (Fig. 12.2; Becker 1999; Phillips 1991). All of the Abu Noshra sites were found buried in marl

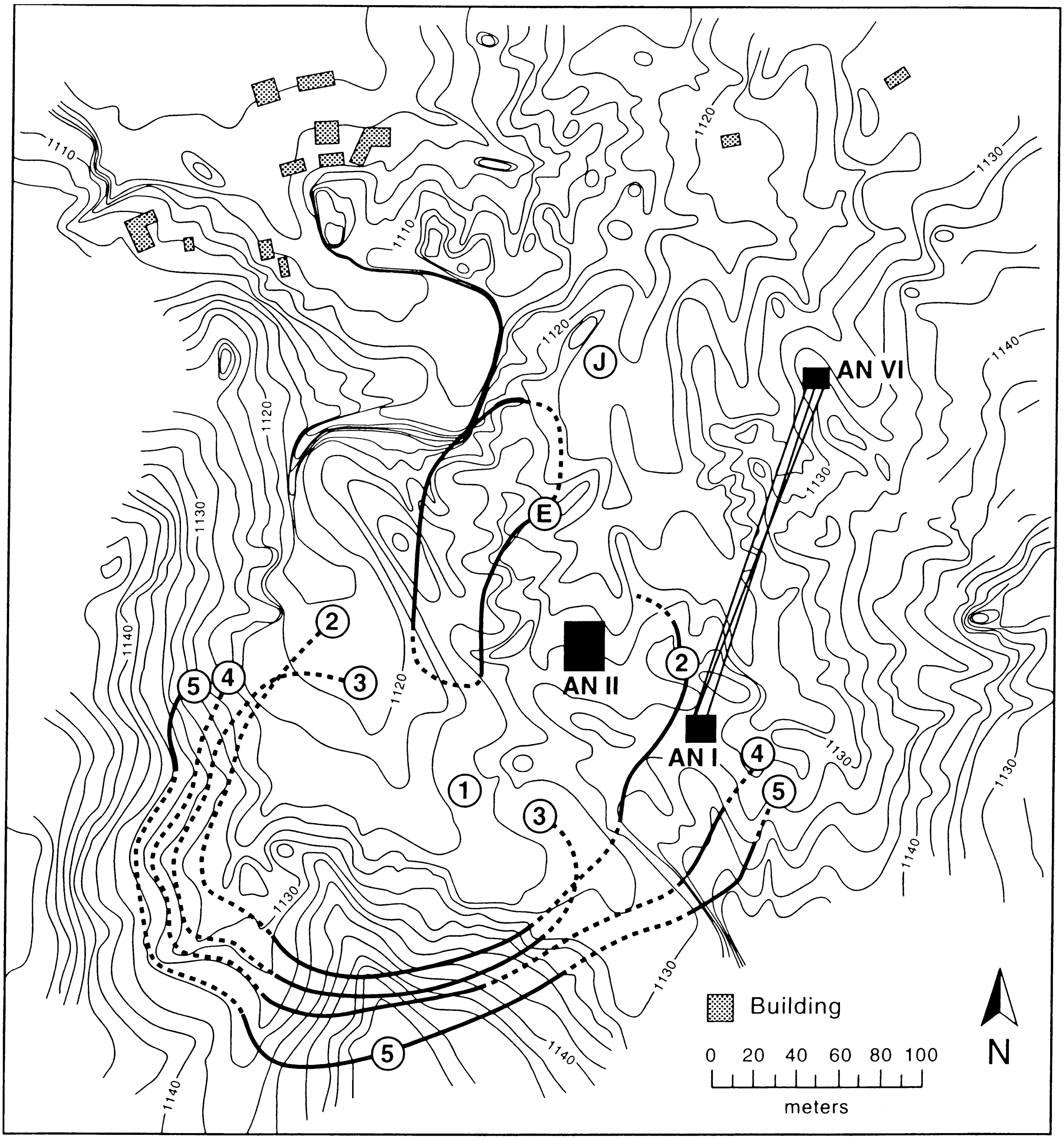

Fig. 12.2 Map showing location of Abu Noshra sites and marl sequences. Note lithic refits between Abu Noshra I and VI. (Adapted from Gladfelter 1990).

sediments that preserved the artefacts in a virtually pristine condition. That is, in addition to fresh edges, the majority of chipped stone artefacts have no traces of patination. The archaeology and geomorphology of the marl sediments indicate that these sites were located along the edge of a palaeo-marsh sequence (Gladfelter 1990; Phillips 1988; see Fig. 12.2). Furthermore, the sites of Abu Noshra I and Abu Noshra II were excavated to expose the entire (identifiable) occupational surface. While many artefacts were point plotted, all artefacts were provenienced by at least ¼ m^2 units. The thickness of the deposits at both of these sites was only *ca.* 10 cm, with no overlapping features, which probably indicates a single, slightly vertically dispersed living surface for each site. Lithic refitting also supports this notion. Hence, the context (and even the size) of these two sites was conducive for intensive lithic refitting and use-wear analyses. The following discussion presents additional details for each site (also see Tables 12.1–2).

Abu Noshra I was originally discovered by Bar-

Yosef's team who placed a test trench over an exposed surface scatter (Belfer-Cohen and Goldberg 1982; Phillips 1988). Further excavations by Phillips between 1984 and 1988 revealed a site that appears to be no larger than 96 m^2, contained 2,512 chipped stone artefacts, four hearth features, and numerous, mostly unidentifiable bone fragments (Becker 1999; Phillips 1988). Identifiable fauna include *Gazella sp.*, *Sus scrofa*, *Equus hemonius*, *Capra ibex*, *Vulpus sp*., and *Canis lupus* (Phillips 1988). Feature 4, an oval pit measuring 1.8×2.3 m with a maximum depth of 35 cm, had an ashy fill indicating that it was probably a roasting pit for an onager whose burnt phalanges and teeth were recovered in the matrix (Phillips 1988:193). Abu Noshra II appears to be no larger than 240 m^2, contained 5,000 chipped stone artefacts, 15 hearth features, a bone point fragment, two handstones and grinding slabs, red ochre, and numerous, mostly unidentifiable bone fragments (see Becker 1999; Phillips 1988). The fauna include, but are not limited to, *Bos primigenius*, *Capra ibex*, *Gazella sp*., *Equus hemionus*, and *Canis lupus* (Phillips 1988).

Early Ahmarian assemblages, such as those from Abu Noshra, have a variety of tool types derived from blade/bladelet cores that are generally based on a single platform removal technique (Gilead 1991; Phillips 1988). The most common tool types are backed blades and bladelets, comprising as much as 45% of the tool assemblages. Other frequent tool types are endscrapers on blades, burins, truncations on blades, notches, and retouched pieces. The closest source of high quality flint for producing the chipped stone assemblages at Abu Noshra is about 20 km to the north at Gebel Dalal (see Fig. 12.1).

The Meer Approach: Methods and Techniques

The Meer Approach involves three methods to reconstruct prehistoric behaviour; lithic refitting, use-wear analysis, and spatial patterning analysis. These methods and techniques were first used together at the Epipalaeolithic site of Meer II in northwestern Europe (see Cahen *et al.* 1979; Cahen and Keeley 1980). The individual components for the Meer Approach are discussed below.

Lithic Micro-wear

First, I used the High Magnification micro-wear approach as described by Keeley (1980) and Vaughan (1985). The High Magnification approach emphasizes 'polishes,' more than other micro-wear techniques (*e.g.*, Odell and Odell-Vereecken 1980), but edge damage and striae are still very important. Polish is the result of contact between the worked material and the lithic artefact, which causes a distinctive alteration on the lithic surface. In other words, the polish appears to be an alteration of the stone, and not an organic residue. In conjunction with other use traces, polishes were used to identify particular worked materials, such as bone/antler, fresh hide, dry hide, meat, soft plant, wood (hard plant), shell, and others. Striae were used to determine the tool action (*e.g.*, cutting, scraping, whittling, drilling, graving, sawing, *etc.*). Edge damage provided a way to check the interpretations, since hard versus soft materials would often leave different degrees of macro (or micro) damage.

For this study, all micro-wear analysis was performed with an incident light microscope with magnifications of 50x to 500x. Artefacts were also cleaned in dilute ammonia, 10% hydrochloric acid, and 10% potassium hydroxide baths to remove dirt, inorganic, and organic materials respectively, so that any micro-wear present could be observed without distortions. After cleaning, artefacts were visually scanned at a magnification of 100x over the entire surface area, with an intense concentration along the artefact edge. Any observed micro-wear polishes were then examined at a higher magnification of 200x or 500x to make polish identifications. Polish identifications were matched to known polishes on experimental tools. Edge damage was identified at both 50x and 100x.

Use-wear samples included 100% of all complete tools, and all tool fragments >2 cm in length (see Table 12.1). I also examined debitage from both sites, which included a 3% random sample of debitage from the entire assemblage that were at least > 2 cm in length. The exclusion of debitage <2 cm is partially justified by a study from Bamforth (1984), who found that debitage <1 cm in dimensions rarely have use-wear traces.[1] In addition, the debitage sample herein excluded virtually all of the artefacts with unusable edges (*e.g.*, extremely thin edges, jagged, broken, *etc.*). In order to obtain a full 3% sample of debitage under these restrictions, some artefacts of lower potential were included in the analysis.

Lithic Refitting

Compared to lithic micro-wear, refitting is relatively straightforward. Cahen and others (1979) point out that refitting flaked stone assemblages is a simple procedure, which involves the reassembling of various artefacts such as tools, flakes, and fragments that have been knapped from the same block. For this project, the refitting involved a systematic attempt to find as many conjoinable flaked stone artefacts (*i.e.*, reduction sequences) in the collections as possible. The only exception being that little attempt was made to refit pieces smaller than 2 cm unless those pieces possessed distinctive characteristics found in distinctive reduction sequences, or were the proximal ends of specific blades. It is important to note that the entire flaked stone assemblage for each site, regardless of provenience, was sorted into consistent raw material and size categories. All of the sites in this study contained flints with substantial and distinctive variations in colour and texture, even for the common chocolate brown flint, and these variations in the raw material made systematic refitting relatively easy. This systematic and

Table 12.1 Site and Artefact Sample Data for Abu Noshra I and II.

	Abu Noshra I	Abu Noshra II
Site Size	96 m^2	240 m^2
Lithic Artefact Totals	2,512	5,000
Thickness of Deposit	10 cm	10 cm
Tool Totals	159	463
Debitage Totals	1,300	1,784
Debris Totals	1,053	2,753
Use-wear Sample: Tools >2 cm in Length[2]	100% (n= 71)	100% (n= 65)
Use-wear Sample: Debitage (no debris)[3]	3% (n= 41)	3% (n= 65)
Refits >2 cm in Length[4]	41.8% (136 of 325)	57.8% (622 of 1,146)
Refits for Assemblage	5.4% (n= 136)	13.2% (n= 622)

comprehensive approach to refitting is important to some of the arguments I make below, since these data were not derived from attempts to refit reduction debris within a single portion of the site, but characterize each site as a whole.

Spatial Patterning Analysis

Spatial patterning was determined primarily from the horizontal distribution of lithic artefacts, feature locations, and lithic refits. The total number of lithic artefacts was tabulated for each unit and then a Surfer program was used to produce contour maps at constant contour intervals showing the distribution of lithic artefacts per square unit. These maps were then used as the basis for observing feature distributions and lithic refits relative to a site's lithic dispersion. The location of features can then be compared to the high and low density areas for either of the sites. In addition, maps were produced to show all lithic refits for these sites. Lithic refit maps were made to the same scale as the Surfer maps and were then used as overlays to directly observe associations (or non-associations) between features (*e.g.,* hearths, lithic concentrations), and groups of artefacts (*e.g.,* refitted blocks). Furthermore, all artefacts with identifiable micro-wear traces were plotted across each site and directly compared to discrete artefact concentrations and other areas within each site.

Results from the Meer Approach

Lithic Refitting: Abu Noshra I

A total of 136 lithic artefacts, or 5.4% (n= 2,512) of the entire lithic assemblage, were successfully conjoined at Abu Noshra I (Table 12.1). However, when artefacts <2 cm are excluded from the sample, as these artefacts are generally too small to refit, 41.8% (n=136 out of 325) of the artefacts were successfully refitted at this site. As observed on the map, the horizontal spatial patterning includes a dense core area with at least 95 artefacts per m^2 (Fig. 12.3). The densest part of the core area has over 900 artefacts in a 2 m^2 area. The core area is surrounded by a low-density area that decreases to five artefacts per m^2, and this area is referred to as the peripheral zone. The core area coincides with Features 1 and 3, two hearths around which most of the activity was centred. Hearths 2 and 4 are located in the peripheral zone, the latter being a large roasting pit where an entire onager was cooked (Phillips 1988). Numerous refits were observed to connect the core area and the peripheral zone (Fig. 12.4). These indicate a pattern of activity around Features 1, 3, and 4, and connections between each (Fig. 12.5). Feature 2 is located immediately beyond the artefact concentration, and its proximity to the peripheral zone indicates a contemporaneous relationship to the rest of Abu Noshra I.

Lithic Refitting: Abu Noshra II

At Abu Noshra II, I was able to refit a total of 662 lithic artefacts, or 13.2% (n= 5,000) of the entire lithic assemblage (Table 12.1). However, when artefacts <2 cm are excluded from the sample, as these artefacts are generally too small to refit, 57.8% (662 of 1,146) of the artefacts were successfully refitted at this site. Nearly 225 m^2 were excavated at Abu Noshra II. As observed on the map, the horizontal spatial patterning at Abu Noshra II indicates two distinct areas of artefact concentrations separated by a zone devoid of artefacts (Fig. 12.6). I refer to the smaller, low-density concentration to the north as Cluster 1, and to the much larger and denser artefact concentration to the south as Cluster 2.

The northern concentration, Cluster 1, covers about 6 m^2 whereas the southern concentration, Cluster 2, covers an area of around 80 m^2. Cluster 2 includes a dense central area with over 95 artefacts per m^2 (see Fig. 12.6). The densest part of the central area has over 200 artefacts in two separate 1 m^2 areas. The central area is surrounded by a low-density area that decreases to five artefacts per m^2, and this area is referred to as the periphery zone. Features 4, 5, and 7 were found in the vicinity of Cluster 1, and

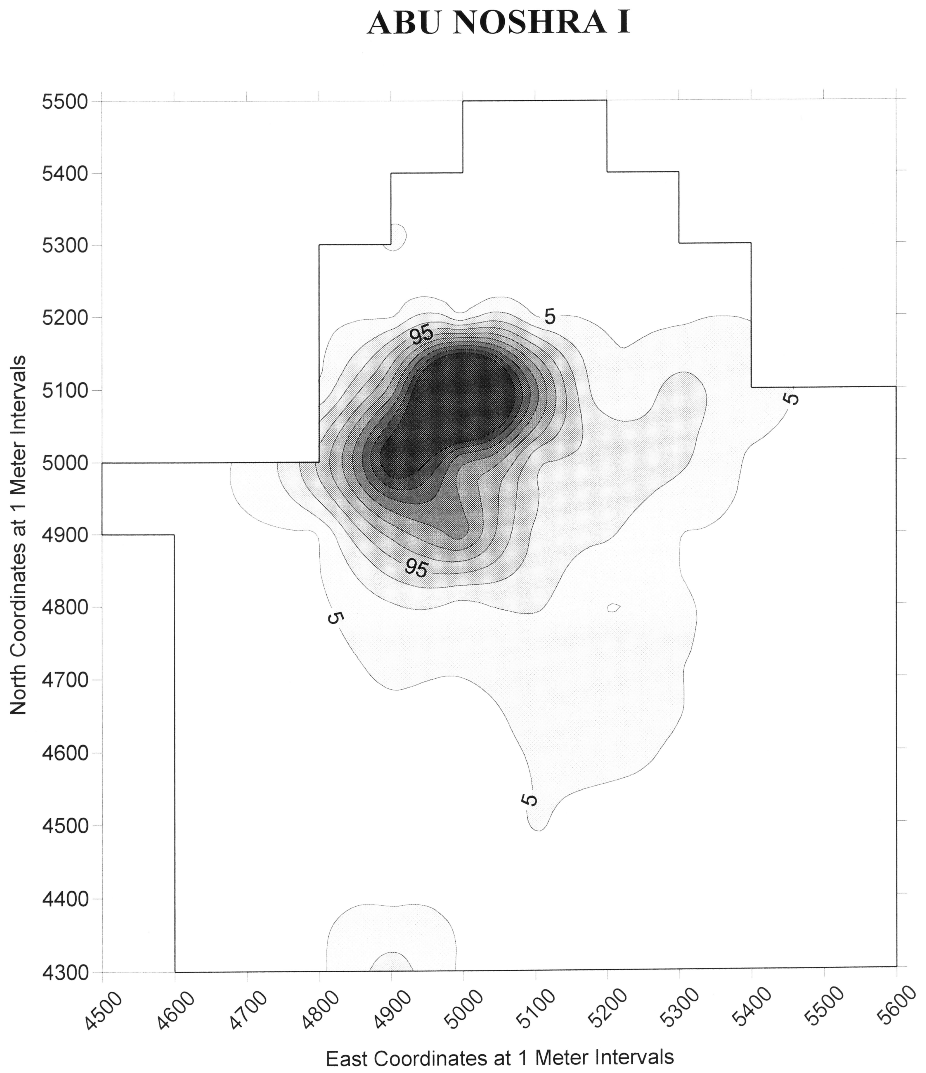

Fig. 12.3 Map showing lithic artefact densities at Abu Noshra I. Contours start at five artefacts per square metre and are then spaced at intervals of thirty.

Features 1, 2/3, 6, 8–10, 12, and 15 were found within Cluster 2 (Fig. 12.7). Most of these features appear to be shallow pits or hearths. One additional feature is AC2B, a concentration of lithic artefacts. The sheer number of cobbles that have at least a few refits within this feature, the high number of items including much debris, and the quantity of artefacts <2 cm in size, indicate that AC2B was a lithic reduction workshop. Finally, between the two clusters is a zone of few artefacts and Features 11, 13, and 14, and this area is referred to as the intermediate zone.

Although separated by at least eight metres, the distribution of lithic refits show that Clusters 1 and 2 are somehow linked to each other (Fig. 12.8). There are several possibilities that can explain these links: 1) geomorphological processes have moved artefacts by disturbing the site; 2) the ‘scavenging’ of artefacts by another group before the site was buried; or 3) this is simply another component of the same site. I use the following observations from lithic refits and the geomorphological interpretation by Gladfelter (1988, 1990) to examine the most likely scenario.

There are three individual sets of lithic refits between Clusters 1 and 2, and as I have suggested elsewhere, the evidence tends to indicate a contemporary occupation area rather than ‘scavenging’ behaviour (see Becker 1999). This is based on different types of evidence such as environmental reconstructions by Gladfelter (1988, 1990) which suggest that this site was located near the edge of a palaeo-pond/marsh, and that it was rapidly covered by low energy marl sediments. When excavated, the site was found relatively undisturbed in these deposits. Hence, soil accumulation and erosion does not necessarily explain the displacement of artefacts by eight metres. Furthermore, the type of lithic refits between Clusters 1 and 2

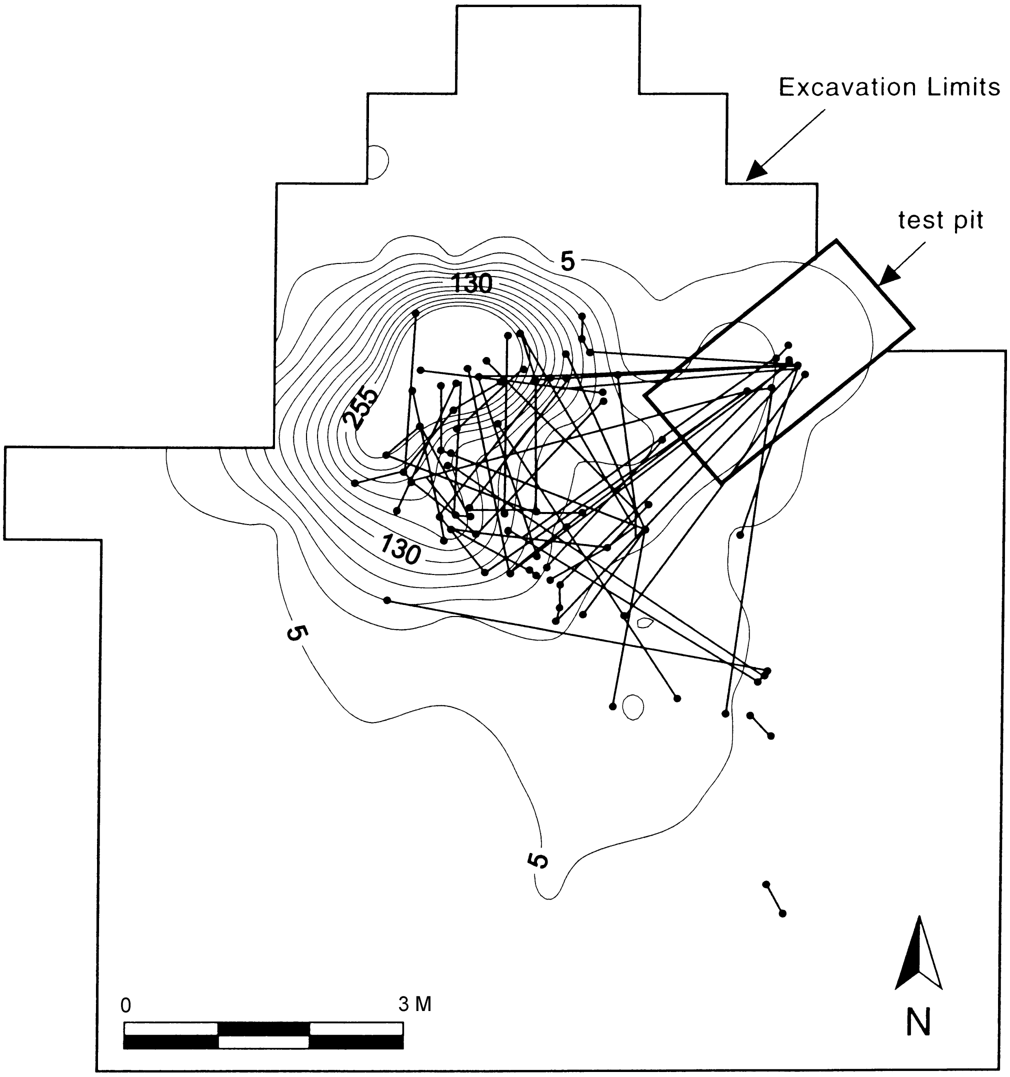

Fig. 12.4 Map showing lithic refits between the core and peripheral areas at Abu Noshra I.

indicates a lack of directionality.[5] That is, each cluster has refits between cores, debitage, and debris. If something such as 'scavenging' occurred, I would expect to see the presence of only useful items, and this would result in only one area having tools or other 'useful' artefacts as compared with the other cluster.

The entire area of Cluster 2 also appears to represent a single contemporary occupation. The clearest example of a refit sequence that demonstrates the contemporary nature of Cluster 2 comes from a reconstructed burin made of a grey and black-banded flint, where ten burin spalls were successfully conjoined to the burin (Figs. 12.9 and 12.10). Burin spall 1 (BS-1) was recovered near[6] Feature 6, BS-2 was found six metres away next to Feature 12, and BS-3 was found two metres away next to Feature 2/3. BS-4 was found eight metres away from Feature 2/3, next to Feature 13, while BS-5 was found seven metres away within AC2B (a lithic reduction area). B-6 (morphologically a blade rather than a burin spall) was recovered a few metres northeast of Feature 1, while BS-7, BS-8, and BS-9 were all found within Feature 1. BS-10 and the burin (B-10) were recovered near Feature 12. Most of these burin spalls were probably discarded at their place of removal near or within the different features, and some are clearly associated with the hearth features. Some of the spalls appear to represent failed attempts to produce a functional working edge with the typical 90° angle. This one case alone, and there are others, indicates that at least a third of the features in Cluster 2 are most likely the result of contemporary activities over a very short span of time.

The Micro-wear Results from Abu Noshra I

Seventy-one formal tools and 41 pieces of debitage were examined for micro-wear at Abu Noshra I, and 38 artefacts had use-wear traces (Table 12.1; also see Becker 1999).

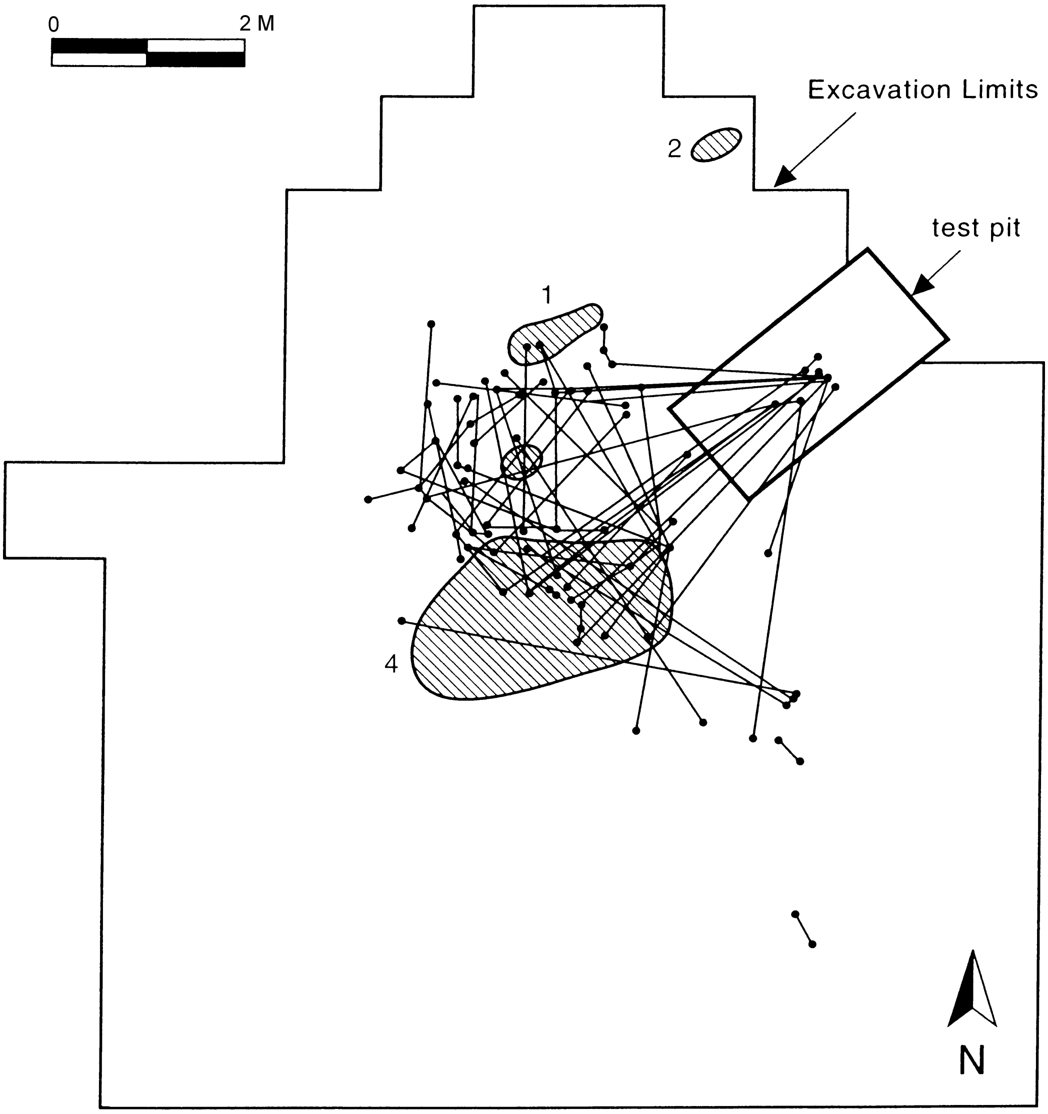

Fig. 12.5 Map showing lithic refits in relationship to features at Abu Noshra I.

Six burins were used for bone scraping. Three artefacts, a blade, a perforator, and a truncation, were used to perforate dry hide. A truncation was also used to cut dry hide. Three artefacts, one perforator and two truncations, were used to pierce fresh hide. A backed blade and a truncation were used to cut fresh hide, and a burin and denticulate were used to scrape fresh hide. Nine artefacts, comprising six blades, two retouched blades, and one backed blade were used for butchery. One blade was used for meat cutting. Finally, a backed bladelet and a burin were used on an unidentified soft material, and a truncation was used on some type of hard material.

One of the most common activities represented by these artefacts is butchery and meat cutting with 10 artefacts accounting for 32% of the identified activities. Bone working is just as common with another 10 artefacts. Fresh hide working is represented by seven artefacts at 23% of the activities, and dry hide working (4 items = 13%) is not very common. The most conspicuously missing activity is woodworking. Cutting traces represent 14 of the identified tool actions accounting for 44% of the activities. The next most common tool actions were scraping at 25% (n=8), piercing at 22% (n=7), and grooving at 9% (n=3). No tools were found with traces indicating use as projectiles, but a backed bladelet with refits between Abu Noshra I and Abu Noshra VI potentially fits into this class. Also notable is an almost complete absence of formal scraper types at Abu Noshra I (but not scraping activities), although they are present at Abu Noshra II (Table 12.2).

The Micro-wear Results from Abu Noshra II

One hundred sixty-five formal tools and 65 pieces of debitage were examined for micro-wear at Abu Noshra

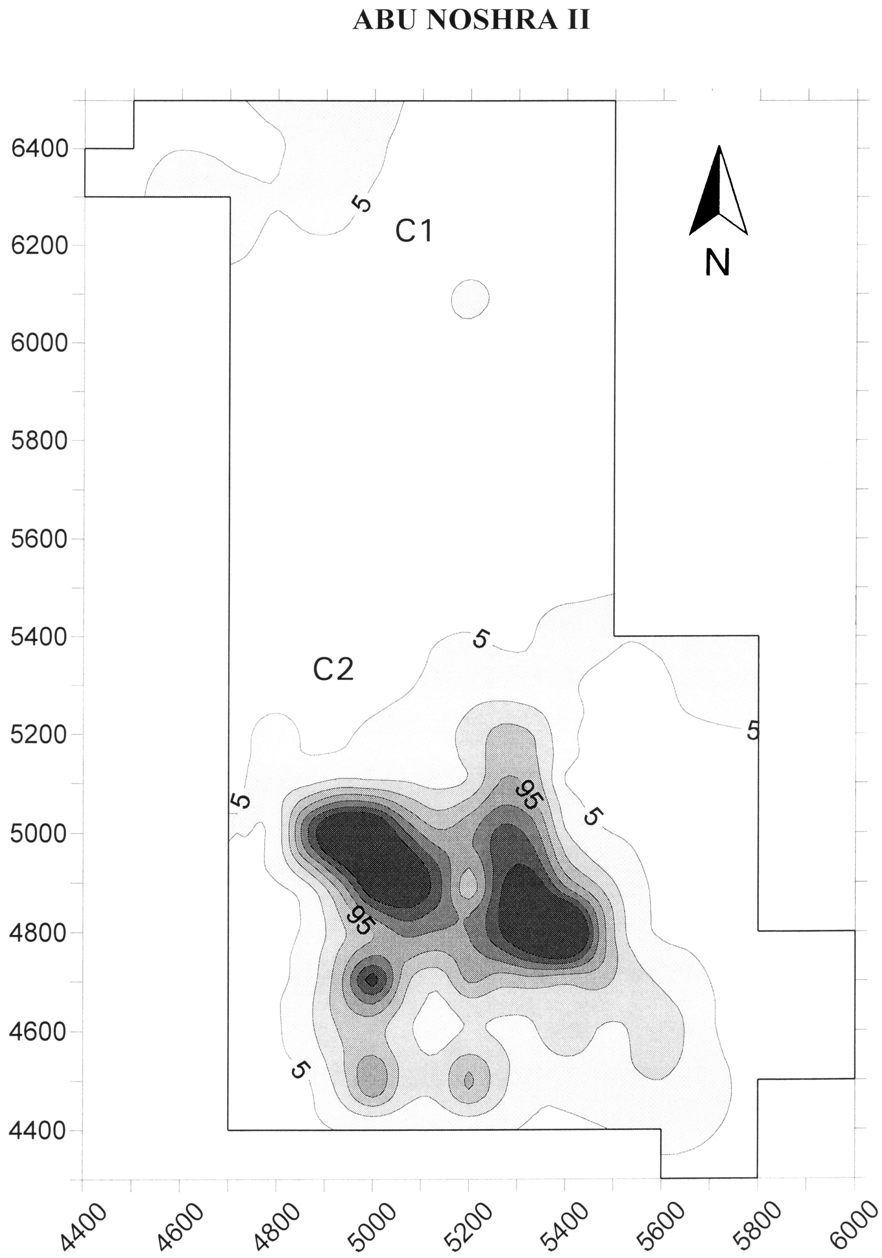

Fig. 12.6 Map showing lithic artefact densities at Abu Noshra II. Contours start at five artefacts per square metre and are then spaced at intervals of thirty. Coordinates at 1 m intervals.

II, and 62 artefacts had use-wear traces (Table 12.1; also see Becker 1999). Of the artefacts that had use-wear, seven burins and one ogival blade were used for bone scraping. Six items were used to groove (rather than engrave) bone. Three artefacts, a blade and two truncations, were used to perforate dry hide. Four tools, including a backed blade, a truncation, and two retouched blades were also used to scrape dry hide. An endscraper-burin was used to scrape greased dry hide on the scraper end of the tool. Ten artefacts, comprising seven endscrapers, one burin, and two retouched blades, were used to scrape fresh hide. A backed blade was also used to cut fresh hide. Thirteen artefacts, that is five blades, two retouched blades, five backed blades, and one sidescraper were used for butchery. Two retouched blades and a truncation were used for meat cutting. Two artefacts had traces that indicated use as projectile points. Those traces included small step fractures parallel to the axis of the

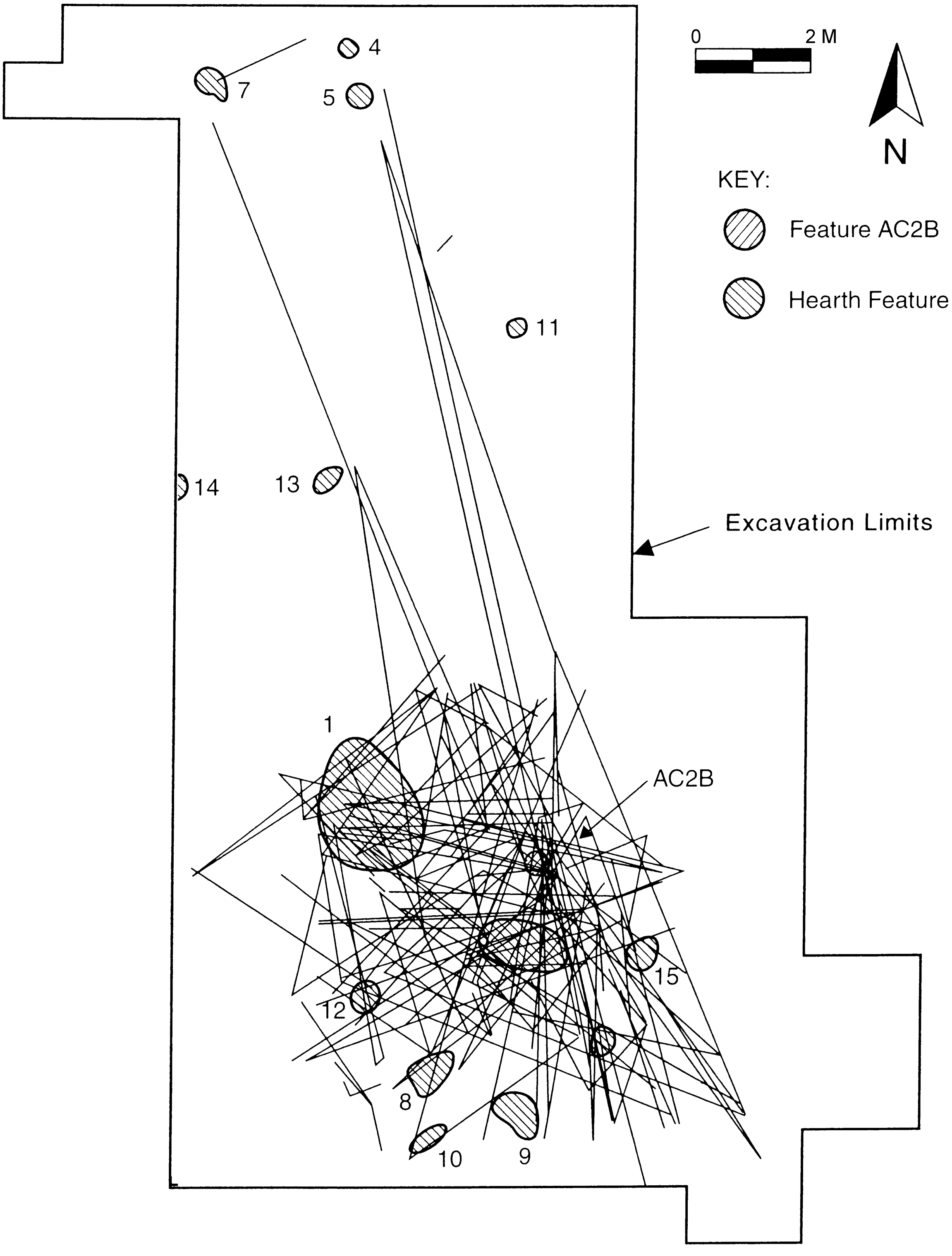

Fig. 12.7 Map showing lithic refits in relationship to features at Abu Noshra II.

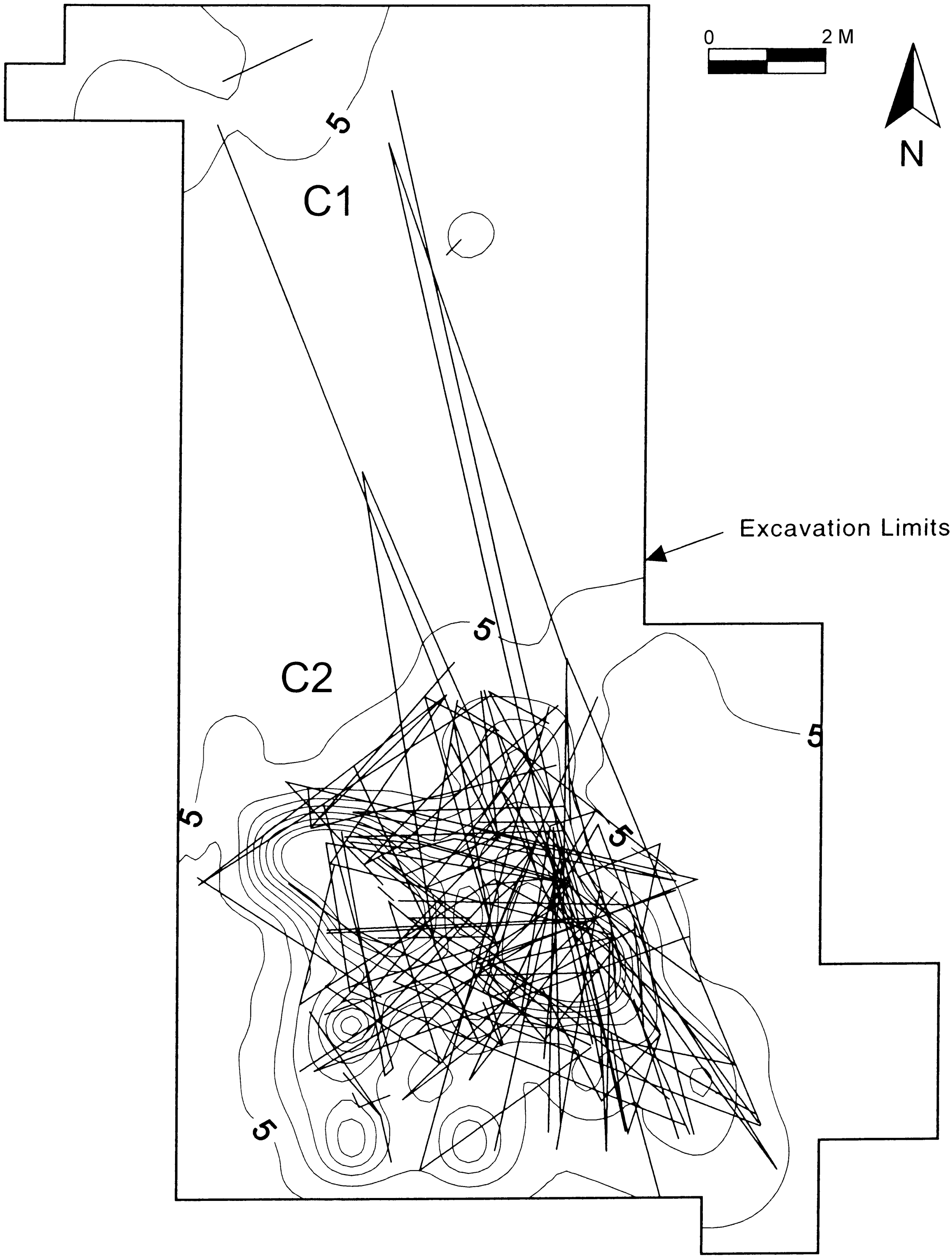

Fig. 12.8 Map showing lithic refits between Clusters 1 and 2 (C1 and C2) at Abu Noshra II. Also note the refits between the core and peripheral areas in C2.

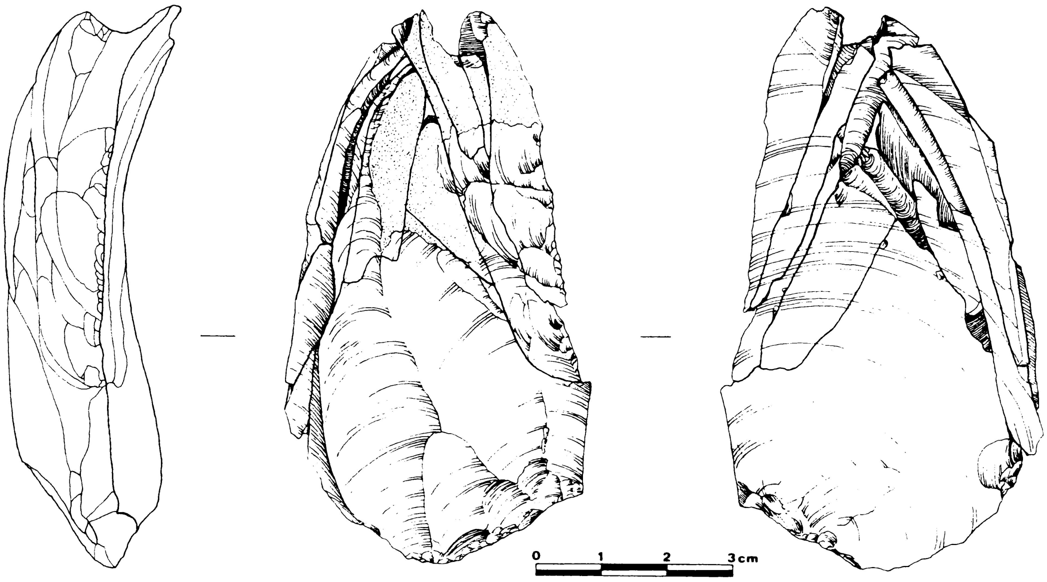

Fig. 12.9 Illustration of gray and black-banded burin reconstruction from Abu Noshra II.

Table 12.2 Tool Frequencies at Abu Noshra I and II.[7]

	Abu Noshra I		Abu Noshra II	
Backed Blade/lets[8]	41	25.8%	118	25.5%
Finely Retouched Blade/lets	32	20.1%	43	9.3%
Ogival Base Blades	0	0.0%	10	2.2%
Truncated Blade/lets	20	12.6%	44	9.5%
Endscrapers	0	0.0%	20	4.3%
Scrapers	0	0.0%	4	0.9%
Endscraper-burin	1	0.6%	4	0.9%
Burins	26	16.4%	37	7.9%
Perforators	10	6.3%	9	1.9%
Notched Pieces	0	0.0%	23	4.9%
Denticulated Blades	2	1.3%	2	0.4%
Retouched Pieces	25	15.7%	127	27.4%
Varia	2	1.3%	22	4.8%
TOTAL	**159**	**100.0%**	**463**	**100.0%**

blade, along with bone and/or meat polish on their tips. Finally, three backed blades, a retouched blade, a truncation, and a blade were used on some type of soft material, often for cutting, and a truncation and varia tool type were used on some type of hard material.

One of the most common activities represented by these chipped artefacts is butchery and meat cutting with 17 artefacts accounting for 38% of the identified activities. Fresh hide working is the next most common activity at 24% with 11 artefacts. Bone working is represented by 10 artefacts at 22% of the activities, and dry hide working is represented by seven artefacts (at 16%), being the least common polish trace. Like Abu Noshra I, the most conspicuously missing activity is woodworking. Scraping traces, indicating tool action, were identified on 24 artefacts accounting for 41% of the activities. The next most common tool actions were cutting at 36% (n=21), piercing at 10% (n=6), grooving at 10% (n=6), and projectiles at 3% (n=2).

Spatial Patterning Observations at Abu Noshra I

Partially based on observations from refitting, micro-wear, and other lines of evidence, at least eight different activities took place at Abu Noshra I, including lithic reduction, butchery, meat processing, hide working, bone working, artefact retooling[9] and maintenance, cooking, and possibly cleaning. Most of the lithic reduction

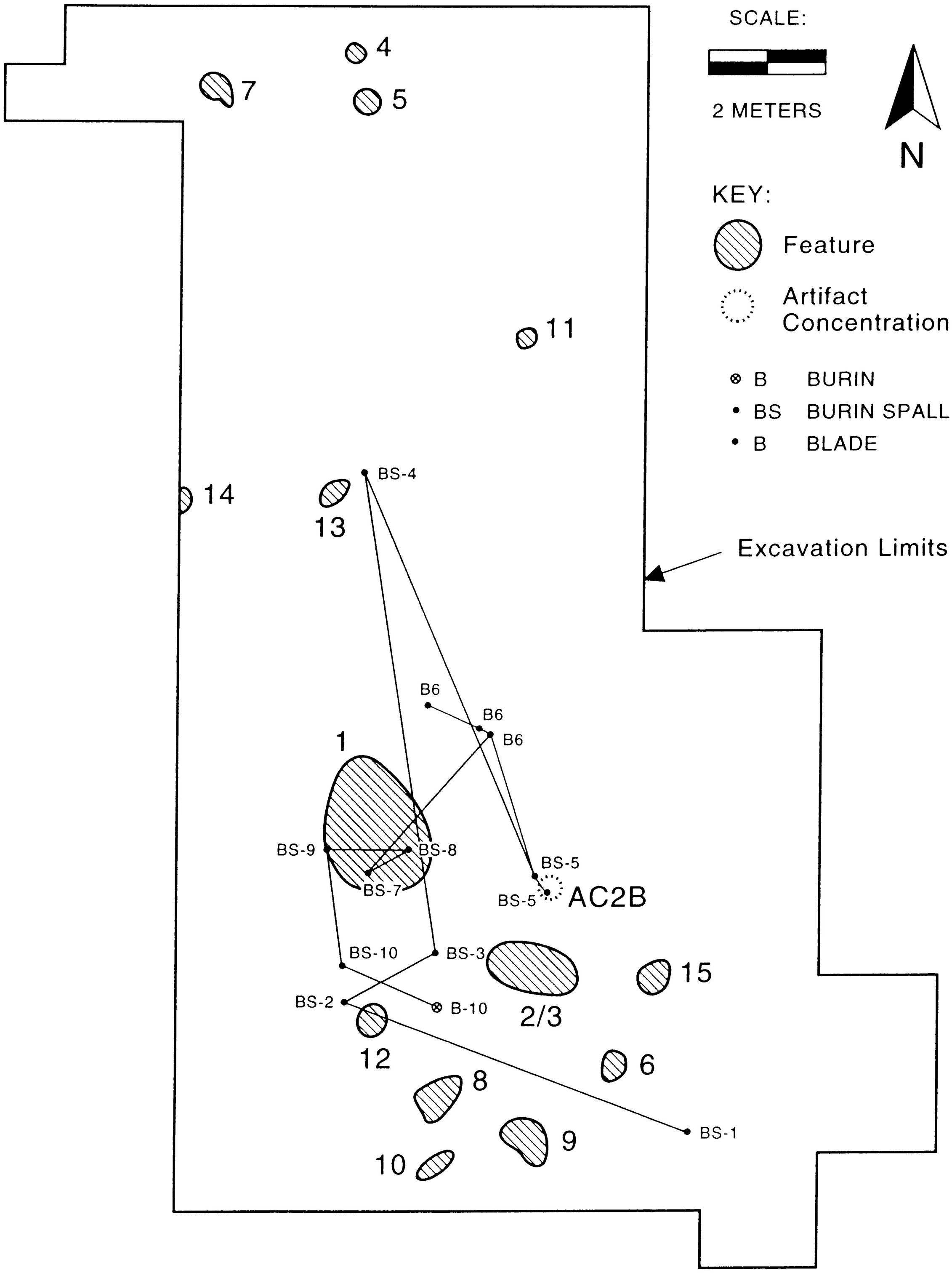

Fig. 12.10 Map showing distribution of artefacts from the gray and black-banded burin reconstruction in association with features at Abu Noshra II. Note that artefacts are numbered consecutively in the order of removal, regardless of artefact type. Also, B6 represents a broken blade with three segments that were each plotted separately. The same was true for BS-5, a burin spall with two segments.

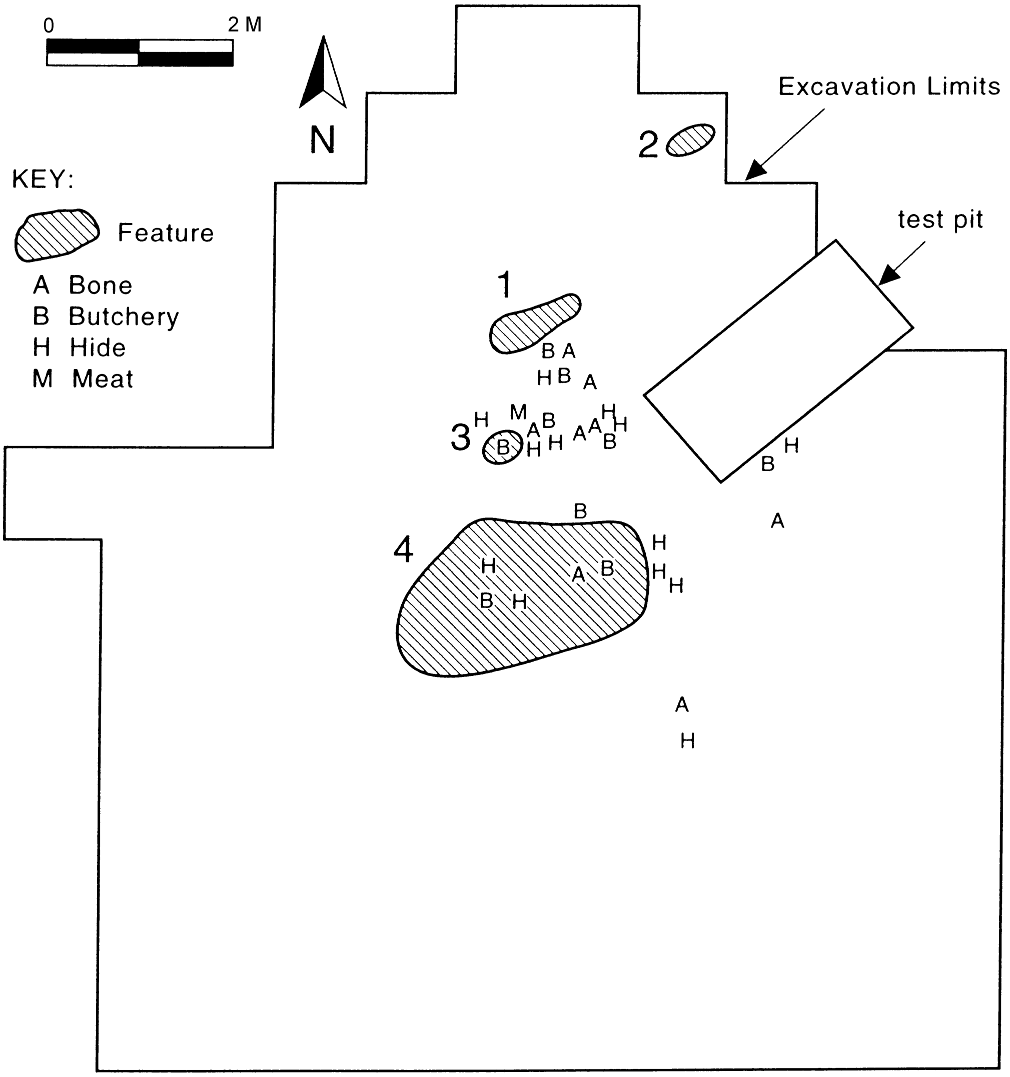

Fig. 12.11 Map showing spatial distribution of artefacts with micro-wear traces at Abu Noshra I.

occurred adjacent to and northwest of Feature 3 (Fig. 12.4). This area is suggested as the primary lithic reduction location for several reasons;

1. This area has a relatively high density of lithic artefacts;
2. It contains relatively large amounts of debitage and debris <2 cm in size, in addition to artefacts spanning the entire size spectrum found on site;
3. Many of the refitted lithic sequences can be traced back to this spot.

However, the highest lithic artefact density is located adjacent to and east of Feature 1, a hearth, with over 600 artefacts in a 1 m^2 area. This area, adjacent to the lithic reduction locale, either represents a lithic dump or a place where artefacts were modified into formal tools since *all* of the artefacts consist of debitage and debris <2 cm in all dimensions. In other words, all of the artefacts from this locale were probably too small to have been used as tools, and it would make little sense to use these artefacts when larger and relatively more suitable debitage were scattered all over the site.

Just like lithic reduction, other activities took place next to hearths. Artefacts with micro-wear traces were found adjacent to Features 1 and 3, and the activities included meat processing, butchery, bone working, and hide processing (see Fig. 12.11). It should be noted that all of the meat/butchery traces occurred on artefact types (such as thin blades and backed blades) that may have been hafted. Thus some of the activities identified on these tools may have been carried out at another location and then brought over to be retooled next to Features 1 and 3. At Feature 4, Phillips (1988) observed several used up burins, and indicated that they may have been retooled at

this location. I would like to make the small distinction that there is no evidence, such as hafting traces, to support the idea that these burins were once hafted tools that were retooled at this location. However, none of the burins at Abu Noshra I could be conjoined with even a single burin spall or any other artefact. Hence, there is no evidence to indicate that these burins were produced or even rejuvenated at the site. It is more likely that these particular tools were transported to and abandoned at this site, with or without further use. In other words, although the use-wear on these artefacts may have originated at another location, it is also possible that these burins were actually used on site and never rejuvenated before abandonment. However, in other cases, the presence of non-refitted burin spalls indicates that some burins were rejuvenated at Abu Noshra I and then removed from the site. Finally, five artefacts with micro-wear traces were observed in Feature 4, but none of the artefacts were burnt, so these tools must postdate the initial use of this feature as a roasting pit. This observation actually reflects a more general issue, namely prehistoric clean-up activities, as this situation was observed for other features, and at other sites.

Spatial Patterning Observations at Abu Noshra II

Just like the case of Abu Noshra I, a number of different activities took place at Abu Noshra II, including lithic reduction, butchery/meat processing, hide working, bone working, artefact retooling and maintenance, cooking, and possibly cleaning. These are partially based on observations from lithic refitting, micro-wear, and other lines of evidence from features and faunal remains. Most of the lithic reduction occurred in Feature AC2B, a concentration of lithic artefacts, just north of Feature 2/3 (Fig. 12.12). This area is suggested as the primary lithic reduction location since:

1. It has a relatively high density of lithic artefacts;
2. This spot contains relatively large amounts of debitage and debris <2 cm in size in addition to artefacts spanning the entire size spectrum found on site;
3. Most of the refitted sequences can be traced back to this location.

However, the highest lithic artefact densities are located next to Features 1 and 2/3, which are both hearths, while Feature 1 also has remains of burnt bone. Both of these areas represent either lithic dumps or places where knapped blanks were modified into formal tools. Each locale comprises over 180 artefacts in a 1 m^2 area, consisting almost exclusively of small debitage and debris <2 cm in all dimensions, although there are some refits and artefacts with use-wear traces.

As observed at Abu Noshra I, lithic reduction, like many other activities at Abu Noshra II, took place next to hearths. Artefacts with micro-wear traces were found near or within Features 1, 2/3, 5, 6, 8, 12, 15, and AC2B, and the activities included butchery/meat processing, bone working, and hide processing (Fig. 12.12). Again, most of the meat/butchery traces occurred on artefact types (*e.g.,* blades, backed blades) that may have been hafted, so that some of these activities could have been carried out at another location and only retooled next to Features 2/3, 5, 15, and AC2B. In other words, while some of these tools show evidence of being produced on-site through the refitting analysis, other tools have no evidence for on-site production. For example, the projectile points found next to Features 15 and AC2B were most likely produced and used off-site, but retooled on-site, as there was no evidence for on-site production in light of the refitting.

Discussion and Conclusions

The virtual lack of intra-site patterning at the Abu Noshra sites indicates that archaeologists need to be extremely cautious in assuming that prehistoric sites were segregated by spatial-functional organization. At Abu Noshra I and II, both sites did have well-defined lithic reduction locales, but there were no specific areas used for butchery/meat processing, hide processing, or bone working. Rather than a discrete location, each of these activities appears to have been performed in multiple locations within the entire site area. I also considered the effects of retooling and eliminated certain activities that may have originated at other sites, potentially adding to activities that occurred on-site, but this did not affect the general patterning (see Becker 1999).

This does not mean that spatial patterning at the Abu Noshra sites is random, or that there is no intra-site spatial patterning, only that this patterning does not conform to the idea of activity-specific areas within the sites. Even the lithic reduction locations, partially defined by discrete concentrations of artefacts, were used for multiple activities, such as blank and tool production (including the production of formal tools and retooling); dumps; and additionally may have been used for processing hide. Also, although lithic reduction is primarily performed at one location for each site, it is not exclusively performed in one area at either of the sites. Instead, virtually all of the activity areas reflect functional similarities, and these areas are frequently connected to each other by refits. This last observation may even have parallels at Boker Tachtit, a transitional Middle to Upper Palaeolithic site (see Marks 1983b). Hietala's (1983a) analysis indicated a generalized activity area in the upper level, as well as a pattern of artefact sharing between concentrations (Hietala and Marks 1981; also see Marks 1993).

Overall, the general pattern seen at the Abu Noshra sites is merely a repetition of the same activities, especially around different hearths. The grey and black-banded burin reconstruction (Fig. 12.9) from Abu Noshra II provides one example of this pattern, as it is likely that a single individual visited Features 1, 2/3, 12, 13, and AC2B while

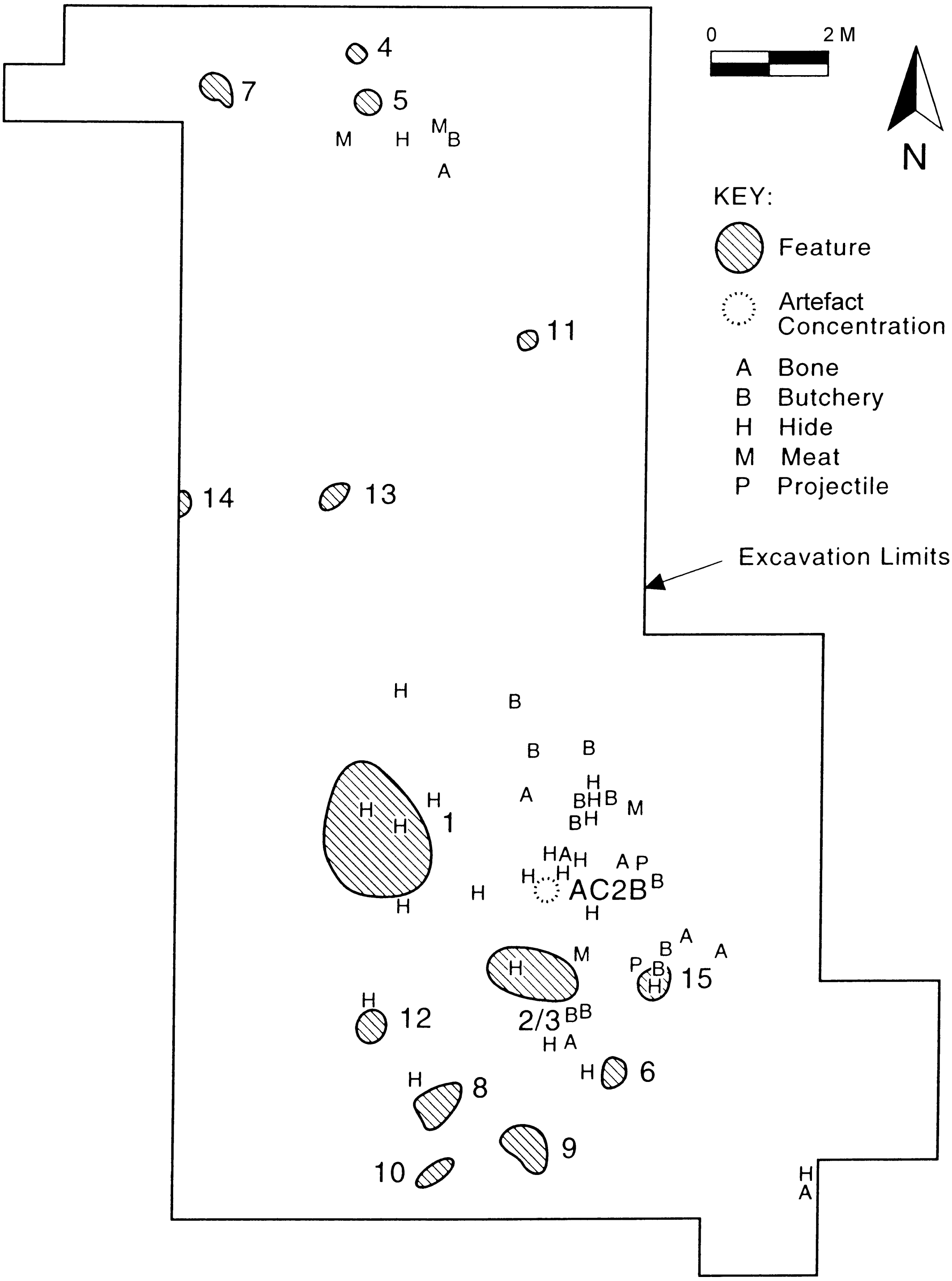

Fig. 12.12 Map showing spatial distribution of artefacts with micro-wear traces at Abu Noshra II.

performing the same activity, probably bone working,[10] during a brief period of time (Becker 1999). However, it is interesting to note that this very activity cannot be seen in the spatial distribution of micro-wear traces (Fig. 12.12), because it left no micro-wear traces on the burin spalls. At the very least, this indicates that the identification of on-site activities can be a complex endeavour, and in this case, too complex to be identified by a single component of the Meer Approach (*i.e.*, micro-wear).

Clearly, there are archaeological sites such as the Epipalaeolithic site of Meer II in north-western Europe, indicating that some sites or at least portions within those sites contain areas that are functionally specific (Cahen *et al.* 1979; Cahen and Keeley 1980). However, as discussed in this paper, the Abu Noshra sites did not contain functionally specific activity areas, especially in

association with discrete artefact clusters. Intra-site spatial patterning of Upper Palaeolithic hunter-gatherer occupations reflects a series of complex activities, even at more specialized sites. At the Abu Noshra sites, these activities included on-site chipped stone tool production, hide processing, the production of bone tool blanks, clean-up activities, gearing-up behaviour, artefact transportation and discard, artefact retooling and maintenance (including the retooling of hunting implements and the maintenance of some burins), butchery/meat processing, and cooking.[11] Hopefully, this study illustrates a very simple but important point for scholars who interpret prehistoric spatial organization and behaviour, or rely on these reconstructions, that point being that archaeologists cannot assume that all or most prehistoric sites will contain similar patterning, such as functionally specific intra-site activity areas. While sites with this type of patterning do exist, in many cases, it may be necessary to investigate site function by using some type of rigorous methodology. Finally, I would like to offer some 'speculation' on the differences in spatial patterning between the Early Upper Palaeolithic Abu Noshra sites and those from western Europe such as Epipalaeolithic Meer II and the Late Upper Palaeolithic Verberie. Perhaps these organizational patterns are related to climate, as the intensity of winters in western Europe would have restricted mobility more acutely than in the Levant. In such a situation, human groups may have formed different kinds of social organization and/or bonds, especially if they had to live in close quarters for part of the year.

Acknowledgments

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Notes

1 Observations by the author also indicate that micro-wear traces on debitage up to 2 cm in dimensions are probably rare at many sites.

2 All tools <2 cm in any dimension appeared to be fragments, but tools that were conjoined, thus exceeding this size range, were examined for micro-wear traces.

3 Many of the more suitable blade blanks were apparently selected by the Early Ahmarian people to produce formal tools, and as mentioned in the text, debitage of lower potential was included in the analysis to reach a 3% sample.

4 Because excavation methods differ (*i.e.*, 1/4 m^2 grid vs. point provenienced), this calculation is offered as a potential means to standardize lithic refitting percentages. It is assumed that other researchers typically focus on artefacts >2 cm for refitting analysis.

5 The absence of artefact directionality related to size also helps to demonstrate the lack of slope within the palaeo-topography of the site, as the presence of a slope could have produced artefact dispersion.

6 The term 'near' is used to imply a distance of around 1–2 metres, while 'next to' is used to imply a distance of 0.5–1 metre, or within reaching distance.

7 The typology for the Abu Noshra sites was adapted from data provided by James Phillips.

8 The lithic tool assemblage at Abu Noshra I contains no more than 11% bladelet tools, while Abu Noshra II contains no more than 5% bladelet tools (personal observation).

9 Following Keeley (1982), the term 'retooling' is used here to refer to the act of replacing the hafted part of a tool in its haft compared to 'rehafting' which implies the replacement of the haft rather than the tool. Maintenance is used to indicate the rejuvenation of a stone tool's edge, such as a burin.

10 Since all the Abu Noshra burins with micro-wear traces were identified as bone working tools, it is assumed that this burin was used for a similar function. This particular burin was found on the surface with a well-developed patina, making micro-wear observations impossible.

11 See Becker (1999) for more details concerning these activities, especially those related to clean-up activities, retooling, artefact transportation and discard, and gearing-up behaviour.

13. The Upper Palaeolithic of Jordan: New Data from the Wadi al-Hasa

Nancy R. Coinman

Introduction

For the last 20 years, most discussions about the Levantine Upper Palaeolithic have focused on a dichotomy in material culture – the Levantine Aurignacian and the Ahmarian (Gilead 1981a; Marks 1981a). Although researchers continue to debate the appropriate criteria to define, describe, and distinguish the Levantine Aurignacian technocomplex, there is a somewhat greater consensus on what is represented by Ahmarian technology and typology. A growing database of Ahmarian sites now includes southern and eastern Jordan. Archaeological research in the al-Hasa area of eastern Jordan since the early 1980's documents an extended chronology of Upper Palaeolithic sites in the eastern basin (Fig. 13.1) which all exhibit a clear association with the Ahmarian. This paper presents evidence for the emergence and evolution of the Ahmarian at a series of sites in which the lithic assemblages illustrate technological and typological trends over a time span of some 20,000 years. It includes a Late Ahmarian that extends at least to *ca.* 19,000 bp, overlapping with the Early Epipalaeolithic in the al-Hasa basin (Olszewski herein) and the Masraqan, a recently defined Early Epipalaeolithic socio-cultural entity (Goring-Morris and Belfer-Cohen 1997). This research adds to a growing database of Ahmarian sites and identifies additional aspects of assemblage variability that characterize the Ahmarian.

The Levantine Upper Palaeolithic

Since the early 1980's considerable efforts have been directed at defining and distinguishing two Upper Palaeolithic traditions or technocomplexes based on technological and typological characteristics, and to some extent, temporal and geographic distributions. The Levantine Aurignacian is thought to exhibit strong similarities to the European Aurignacian, featuring typical Upper Palaeolithic tools, such as endscrapers and burins, especially 'Aurignacian,' carinated, and nosed varieties, as well as bone and horn core tools (Neuville 1934; Garrod 1953; Belfer-Cohen and Bar-Yosef 1981; Bar-Yosef and Belfer-Cohen 1988; Belfer-Cohen 1994; Gilead 1991). Core reduction was focused predominantly on flake debitage and tool blanks with low proportions of blades and bladelets. Lithic assemblages from some sites in the Negev, such as Ein Aqev (Marks 1976b), Sde Divshon (Ferring 1976), and Arkov (Larson and Marks 1977) have been identified as having Aurignacian elements, exhibiting a relatively inferior blade technology as seen in large, thick blades and the lack of a true bladelet technology (Marks and Ferring 1988:46, 64–65; Gilead 1991:128). However, some question the applicability and relevance of the Levantine Aurignacian to all flake-based assemblages, particularly those outside the core Mediterranean area (*e.g.*, Bergman and Goring-Morris 1987; Belfer-Cohen and Bar-Yosef 1981; Belfer-Cohen and Goring-Morris 1986), emphasizing the original definition of the Levantine Aurignacian (Belfer-Cohen 1994:247). The Ahmarian, in contrast, is currently recognized as a well-developed blade technology that is dominated by the production of blades and small bladelet tools, many of which are retouched, backed, or pointed (Gilead 1981a, 1989, 1991; Marks 1981a, Marks and Ferring 1988). Traditional Upper Palaeolithic tools, such as endscrapers and burins, occur less frequently.

The Levantine Aurignacian has been found in caves and rockshelters in Lebanon, Syria, and Israel at such sites as Ksar Akil (Copeland 1975; Tixier and Inizan 1981; Bergman 1987a, 1988a, b; Bergman and Goring-Morris 1987; Ohnuma and Bergman 1990), Erq el-Ahmar B (Neuville 1951), el-Quseir C (Perrot 1955), el-Wad C (Garrod and Bate 1937), Kebara D (Garrod 1954; Ronen 1976; Ziffer 1978), Hayonim D (Belfer-Cohen and Bar-Yosef 1981; Bar-Yosef and Belfer-Cohen 1988), and at Sefunim (Ronen 1976, 1984). Fazael IX in the lower Jordan Valley (Goring-Morris 1980b) and Nahal Ein Gev I (Bar-Yosef 1973) in the northern Jordan Valley are also designated as Levantine Aurignacian sites (Kaufman 1987). Edwards *et al.* (1988) identified Upper Palaeolithic sites in the Wadi Hammeh (WH 32 and WH 34) as Levantine Aurignacian, while other sites in the lower Jordan Valley have been attributed to the Levantine

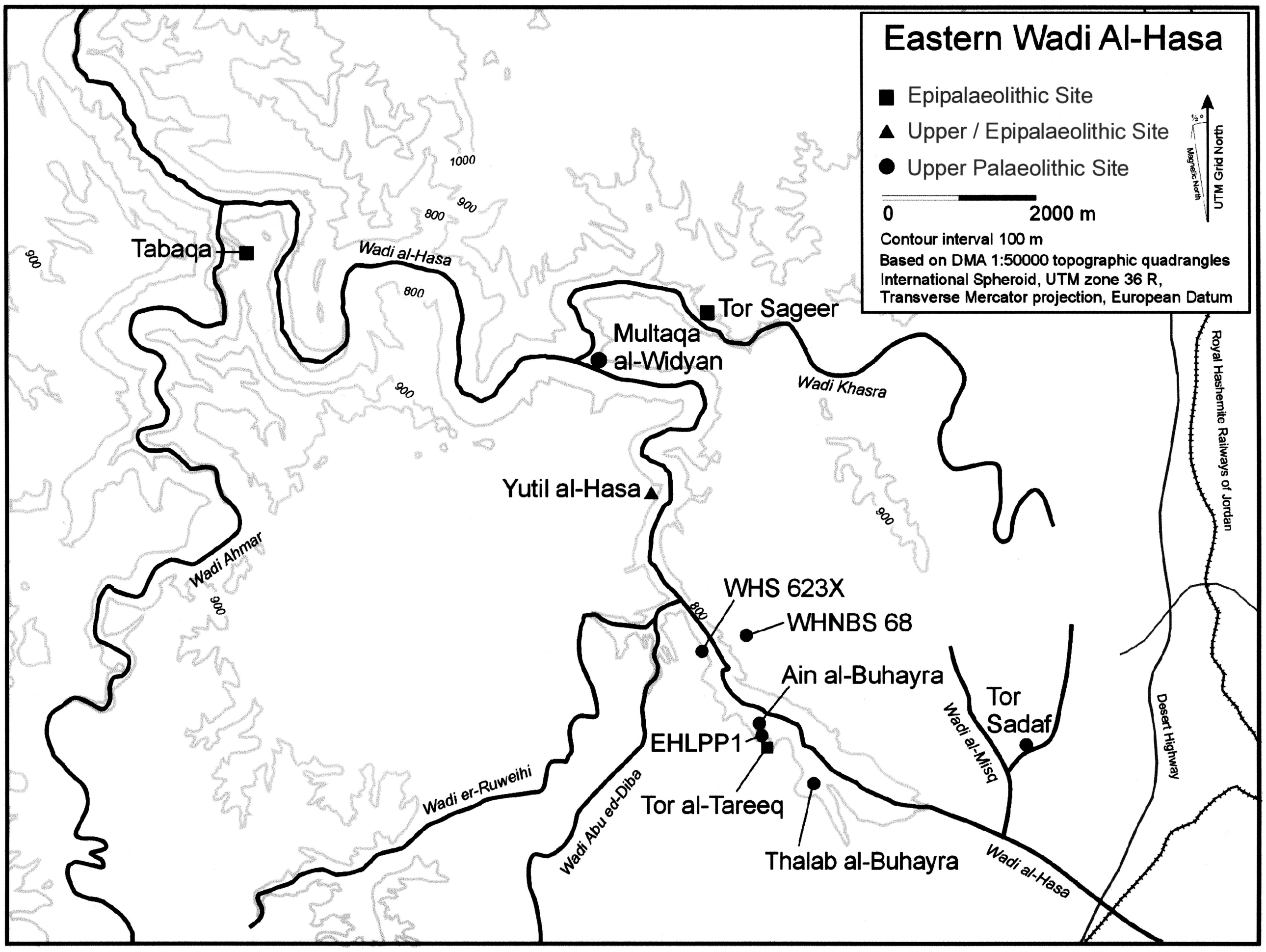


Fig. 13.1 Map of the eastern end of Wadi al-Hasa, showing the locations of Upper Palaeolithic sites discussed in text.

Aurignacian by Muheisen (1988). The Levantine Aurignacian is also present in the southern Levant at a number of sites in the Negev (*e.g.,* Ein Aqev, Sde Divshon, Arkov) (Marks 1976b; Marks and Ferring 1976; Larson and Marks 1977; Marks and Ferring 1988) and in Sinai (Baruch and Bar-Yosef 1986). In southern Jordan, the sites of Tor Aeid (J432) and Jebel Humeima (J412) were identified initially as Levantine Aurignacian (Henry 1986; Coinman and Henry 1995), but more recently these have been reassessed as Ahmarian sites (Coinman 1998a; Kerry 1997a, 2000; Williams 1997a, b).

The Ahmarian, as currently understood, is known from sites throughout the Sinai at Gebel Maghara (Bar-Yosef and Belfer 1977; Gisis and Gilead 1977; Gilead 1977; Goring-Morris 1987), Qadesh Barnea (Gilead and Bar-Yosef 1993), and Wadi Feiran (Phillips 1988; Gladfelter 1990,1997). Ahmarian sites are well documented in the central Negev (Jones *et al.*1983; Ferring 1977) and western Negev (Goring-Morris 1987), the Judean Desert (Neuville 1951; Perrot 1955), as well as in cave and rockshelter sites in the core Mediterranean zone (Ronen and Vandermeersch 1972; Ronen 1976, 1984; Goring-Morris 1980b), and as far north as Lebanon (Ohnuma and Bergman 1990) and southern Turkey (Kuhn *et al.* 1999). Ahmarian sites have been identified in southern Jordan (Kerry 1997, Williams 1997a, b) and in the Wadi al-Hasa of west-central Jordan (Coinman 1993b, 1997a, b; 1998a, b; 2000; Coinman and Fox 2000; Fox and Coinman 2000; Fox herein; Olszewski 1997; Olszewski *et al.* 1990, 1994). The Ahmarian has also been documented at a number of sites in the Petra area (Schyle and Uerpmann 1988; Schyle and Gebel 1997), and it also may be present at sites in the Azraq basin (Garrard *et al.* 1988b, 1994; Byrd 1988; Coinman 1998a, 2000).

Issues concerning the contemporaneity and potential evolutionary relationship between the Levantine Aurignacian and the Ahmarian technocomplexes have been central to discussions of the Levantine Upper Palaeolithic. Some researchers have interpreted the superposition of Levantine Aurignacian assemblages over earlier Ahmarian assemblages to represent a developmental succession from earlier Ahmarian blade-based technology into a flake technology in the later Levantine Aurignacian (Copeland 1986; Bergman and Goring-

Morris 1987; Goring-Morris 1987) or as an 'evolved' Levantine Aurignacian (Marks and Ferring 1988:64–65). Others have argued that there is minimally a temporal overlap between *ca*. 29–20,000 bp between the two (Marks and Ferring 1988:68), or that they are partially contemporaneous until *ca*. 26,000 bp (Phillips 1994:170).

Currently, there are more radiometric dates for Ahmarian assemblages and sites dating between 43–26,000 bp (Bar-Yosef *et al*. 1996; Jones *et al*. 1983; Marks and Ferring 1988; Phillips 1988, 1994), but Late Ahmarian sites dating to the time range between *ca*. 26–20,000 bp or later are limited and restricted to the southern and eastern regions of the Levant. Phillips (1994:170) has questioned the existence of the Late Ahmarian in Jordan and the Negev, arguing that the [Early] Ahmarian existed for only about 12,000 years and was then replaced by the Levantine Aurignacian *ca*. 26,000 bp. Indeed, the Late Ahmarian, as the terminal Upper Palaeolithic (Goring-Morris 1987, 1995b), has been re-classified as the Masraqan, representing the Early Epipalaeolithic (Goring-Morris and Belfer-Cohen 1997). The Masraqan is dated between *ca*. 20–15,000 bp and includes sites that are identified by others as late Upper Palaeolithic Ahmarian, *e.g.*, Ain al-Buhayra (WHS 618) in the Wadi al-Hasa (Coinman 1990, 1993, 1997a, b; 1998a, b; 2000) and Ein Aqev East in the Negev (Ferring 1977, 1980, 1988; Marks and Ferring 1988; Coinman 1990, 1993), as well as other sites, *e.g.*, Ohalo II, Fazael X, Azariq XIII and Shunera XVI, with assemblages that include both Late Ahmarian and Early Epipalaeolithic small bladelet tools (Goring-Morris and Belfer-Cohen 1997).

In Jordan, interpretations of Upper Palaeolithic sites have evolved over the course of the last 20 years. Known since the early 1980's as a result of surveys by MacDonald (1988), Henry (1979, 1982) and Clark (Clark *et al*. 1992, 1994), it was unclear from the beginning *if* and *how* these eastern Levantine sites fit into the established Ahmarian and Levantine Aurignacian cultural framework. Surveys and excavations in southern Jordan by Henry (1979) were among the first well-documented examples of the Upper Palaeolithic in the eastern regions of the Levant. The lithic assemblages at the rockshelters of Jebel Humeima (J412), Tor Aeid (J432), and other sites in southern Jordan were initially identified as Levantine Aurignacian (Henry 1982, Coinman and Henry 1995), but more recent evaluations have demonstrated that the technology in these assemblages is clearly Ahmarian (Williams 1997a, b; Kerry 1997a). After the initial identification of Upper Palaeolithic sites through surveys in the al-Hasa basin by MacDonald (1988), preliminary investigations at Ain al-Buhayra (WHS 618) identified this site as Levantine Aurignacian (Clark *et al*. 1987, 1988), while later subsurface investigations indicated the possibility that both the Levantine Aurignacian and the Ahmarian were present at WHS 618 (Coinman 1990, 1993). This assessment has since been revised, especially on the basis of renewed excavations in 1997 (Coinman 1997a, b, c; 1998a, b; 2000; Olszewski *et al*. 1998). Together with newly identified Ahmarian sites, the data from the al-Hasa area provide new insights into the nature of the Ahmarian technocomplex.

Ahmarian Chronology in the Hasa Basin

Upper Palaeolithic sites in the Wadi al-Hasa area (Fig. 13.1) now provide an extended chronology for the Ahmarian, beginning with the undated Early Ahmarian at Tor Sadaf and ending with the Late Ahmarian *ca*. 19,000 bp (Fig. 13.2). The Tor Sadaf assemblage probably dates to 30–38,000 bp based on similarities with other dated Early Ahmarian assemblages, such as Boker A in the Negev (Marks and Ferring 1988; Marks 1993; Monigal herein), Abu Noshra I–II (Phillips 1988, 1994) and Qadesh Barnea (Gilead and Bar-Yosef 1993) in Sinai. Indeed, the Ahmarian assemblage at Tor Sadaf may date earlier given its direct stratigraphic relationship to and origin within earlier transitional occupations at the site (Coinman and Fox 2000; Fox 2000, herein; Fox and Coinman 2000). Two other sites exhibit transitional and very early Upper Palaeolithic characteristics but have only been subjected to limited investigations in order to evaluate the nature and extent of such early technologies. These are Multaqa al-Widyan (WHNBS 195) at the confluence of Wadis al-Hasa and Khasra (Olszewski *et al*. 1998:62), and northern areas of Ain al-Buhayra (WHS 618) (Coinman 2000:147). Extensive surface assemblages recovered in 1984 from the large, open-air site of Ain al-Buhayra (Clark *et al*. 1987), in conjunction with evidence from subsurface testing in 1997 across the site (Olszewski *et al*. 1998), have revealed a long technological sequence. This includes deflated transitional Middle/Upper Palaeolithic and Early Ahmarian components in the far northern part of the site, which are known only from the remnant surface assemblages.

Although undated, the technology of the knapping site of WHS 623X with 11 refitted cores is Early Ahmarian (Lindly *et al*. 2000), as is the small, untested site of WHNBS 68, both near the juncture of the Wadi al-Hasa and the Wadi er-Ruwayhi (Olszewski *et al*. 1998:56). The recently tested site of EHLPP 1 exhibits a clearly defined Early Ahmarian core technology and tool assemblage, as well as a later Ahmarian occupation in the upper levels (Olszewski *et al*. 1998; Coinman 2000).

One of the more interesting results of recent investigations by the Eastern Hasa Late Pleistocene Project (EHLPP) has been the discovery of a *late* phase of the Early Ahmarian at Thalab al-Buhayra (EHLPP2). Two of the three areas excavated to date have produced radiometric dates between *ca.* 25–24,000 bp in association with assemblages that exhibit technological and typological characteristics most closely related to the Early Ahmarian (Table 13.1) (Coinman *et al*. 1999; Coinman 2000). Locus C at Thalab al-Buhayra documents one of the earliest known occupations at this site and is dated by

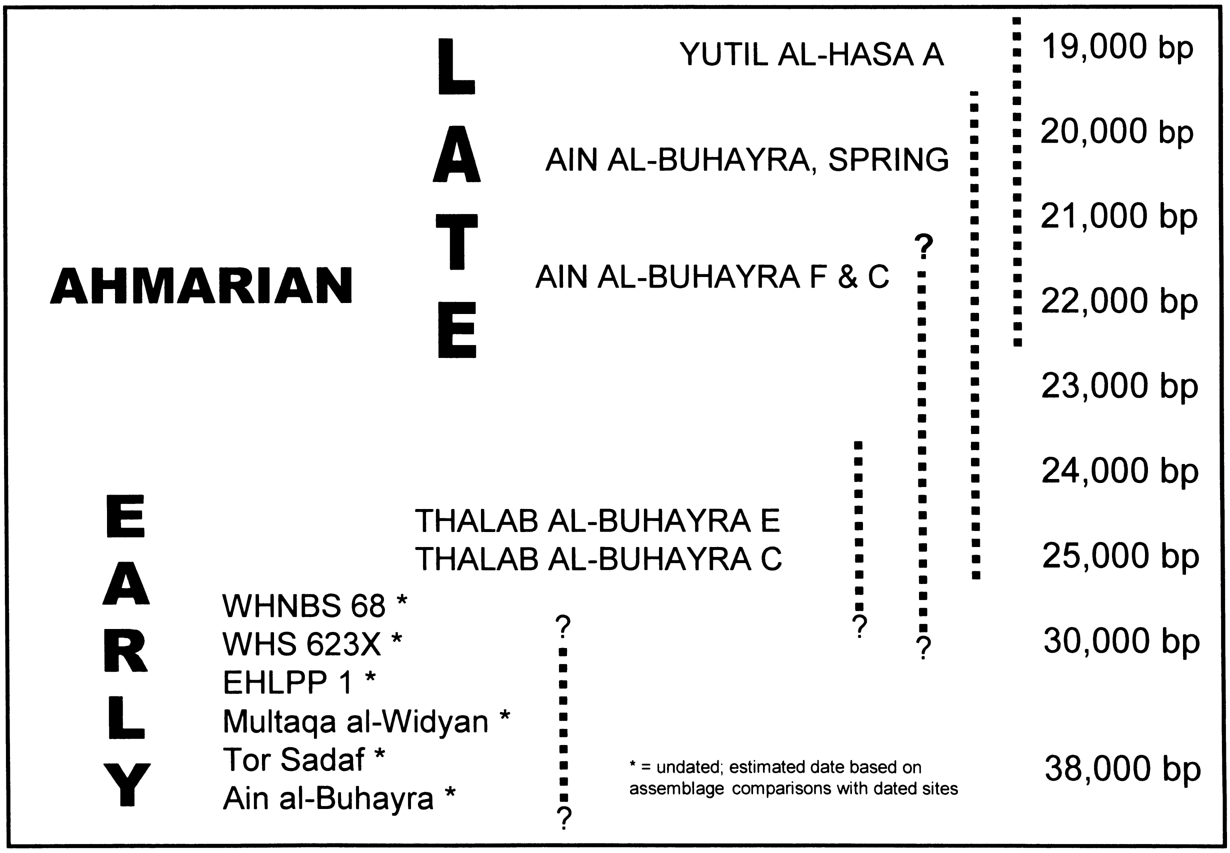


Fig. 13.2 Chronology of Upper Palaeolithic sites in Wadi al-Hasa.

an AMS radiocarbon date to 25,690±100 bp (Beta-129818), although there is new evidence of an earlier occupation below this one (Olszewski *et al.* in press). Locus E at Thalab al-Buhayra is stratigraphically above and horizontally separated from Locus C by some 20 m. A hearth at Locus E has been dated to 24,900±100 bp (Beta-129817).

The relatively later Early Ahmarian assemblages at Thalab al-Buhayra appear to co-occur with some of the Late Ahmarian assemblages at Ain al-Buhayra (WHS 618) (see Table 13.1). On the middle slopes of the site in Areas F and C, the Late Ahmarian is represented in dense, derived deposits (Area C) and in dark marshy organic sediments (Area F), which have been dated to 25,590±440 bp (Beta-55928) (Schuldenrein and Clark 1994:34). In the southern portion of the site at the spring (formerly referred to as Areas H and I), expanded excavations were carried out in 1997. Four radiocarbon dates have been obtained from the stratified sequence of lacustrine marls, spring tufas, and cultural sediments that form the spring-tufa formation in this portion of the site (Coinman 2000:150). The stratigraphically lowest date at the spring tufa formation is 23,560±250 bp (Beta-55931) (Schuldenrein and Clark 1994:34), which dates an underlying organic marsh silt band that occurs between layers of marls and is *ca.* 20 cm below the lowest known cultural deposits at the spring. Above this is an early occupation that is located between 60–80 cm below the surface. A 1 m² test unit revealed an assemblage dominated by the remains of large fauna and undiagnostic lithics. Directly above this early occupation at *ca.* 60 cm below the surface, soil sediments have been dated to 18,960±580 bp (Beta-55933) (Schuldenrein and Clark 1994:34). This is clearly anomalous since it is succeeded by a cultural hiatus and consolidated, inter-stratified tufa and marl sediments some 25 cm thick. These, in turn, are overlain by a well-dated Late Ahmarian occupation. The upper loose cultural sediments contain a high density of lithics and a well-preserved faunal assemblage in association with numerous hearth remnants, three of which have been radiometrically dated. One, dated to 23,500±270 bp (Beta-56424) was exposed on the south side of the tufa formation (Schuldenrein and Clark 1994:34). Another hearth was exposed through excavation (Feature 1, Test I) and dated to 20,300±600 bp (UA-4395[1]) (Clark *et al.* 1987:40; Schuldenrein and Clark 1994:34). Charcoal-laden sediments from a third hearth (Feature 2, E68,N42) are dated to 20,670±600 bp (Beta-118757) (Coinman 2000:150).

During this same time period, there is one other well-dated Late Ahmarian site in the al-Hasa basin. This is the

Table 13.1 Radiocarbon Dates from Upper Palaeolithic Sites in Wadi al-Hasa.

Site	Radiocarbon Date (bp)	Context	Material	Laboratory No.
Yutil al-Hasa (WHS 784) Area A Upper	19,000±1300	Unit A, L.2A hearth	charcoal	UA-4396
Ain al-Buhayra (WHS 618 Spring)	20,300±600	Test I, L2 hearth	charcoal in tufa/marl sediments	UA-4395
Ain al-Buhayra (WHS 618 Spring)	20,670±600	E68,N42, L.6 hearth	charcoal in tufa/marl sediments	Beta-118757
Yutil al-Hasa (WHS 784) Area A Lower	22,790±80	Unit B, hearth	charcoal	Beta-129813
Ain al-Buhayra (WHS 618 Spring)	23,500±270	South profile ~15 cm below surface; probable hearth	charcoal in tufa/marl sediments	Beta-56424
Ain al-Buhayra (WHS 618 Spring)	18,960±580*	South profile ~60 cm below surface	soil sediment in tufa/marl deposits	Beta-55933
Ain al-Buhayra (WHS 618 Spring)	23,560±250	South Profile ~0.8 m below surface	organic sediment	Beta-55931
Ain al-Buhayra (WHS 618 Area F)	25,950±440	20–30 cm below surface	organic sediment	Beta-55928
Thalab al-Buhayra (EHLPP2 E)	24,900±130	Locus E, Unit B5, Level 4 hearth	charcoal in soil sediments	Beta-129817
Thalab al-Buhayra (EHLPP2 C)	25,680±100	Locus C, Unit K3, Level 3	charcoal in soil sediments	Beta-129818

*Date appears to be anomalous as it occurs stratigraphically within older dated contexts.

rockshelter of Yutil al-Hasa (WHS 784), first tested in 1984 (Clark *et al*. 1987; Olszewski *et al*. 1990) and re-opened in 1993 (Olszewski *et al*. 1994; Olszewski 1997) and 1998 (Coinman *et al*. 1999). Charcoal from one of the lowest levels at this site in Unit A (Level 19) has been dated recently to 22,790±80 bp (Beta-129813) (Olszewski, herein), while a hearth in the upper levels of the unit (Level 2A) was dated to 19,000±1300 bp (UA-4396) (Clark *et al*. 1987:47). Therefore, the Late Ahmarian at Ain al-Buhayra and Yutil al-Hasa provides solid dates for the latest phase of the Ahmarian. The occupations at Ain al-Buhayra appear to span a period from *ca*. 25–20,000 bp and overlap the waning Early Ahmarian, as it is currently known from Thalab al-Buhayra. Similarly, the Late Ahmarian now appears to overlap with the Early Epipalaeolithic at the site of Tor Sageer (see Olszewski 2000 and Olszewski herein for a discussion of the Late Upper Palaeolithic and the Early Epipalaeolithic in the Hasa basin).

Ahmarian Continuity and Change

Until recently it was difficult to identify the origins of the Ahmarian in the Wadi al-Hasa basin. There appeared to be abundant *late* Upper Palaeolithic sites in the Hasa, but *Early* Ahmarian sites were unknown. Middle Palaeolithic sites with Levallois technologies have been documented at Ain Difla (WHS 634 – Tabun D type) (Lindly and Clark 1987, Clark *et al*. 1997), and at WHS 621 (Clark *et al*. 1987; Potter 1993). With the excavations at Tor Sadaf, we are now able to anchor the origins of the Ahmarian in the transitional levels at this rockshelter site. The Early Ahmarian evolves very unambiguously and directly out of a late transitional technology in a continuous strati-

graphic sequence at Tor Sadaf (Fox and Coinman 2000; Coinman and Fox 2000; Fox 2000 and herein). The transitional assemblages have been divided into earlier (Tor Sadaf A) and later (Tor Sadaf B) occupation periods[2] based on gradual changes in core reduction strategies, debitage, and tool production. The overlying early Upper Palaeolithic levels, in turn, exhibit important related changes from the underlying transitional levels. Thus, a true Upper Palaeolithic blade technology emerges gradually from at least two earlier transitional phases rather than appearing abruptly as a stratigraphically separate occupation. Fox (herein) provides a more complete discussion of the changes between the transitional and the Early Ahmarian assemblages at Tor Sadaf.

Evidence from other Upper Palaeolithic sites in the al-Hasa basin now suggests that the Upper Palaeolithic Ahmarian technology that emerges from the transitional levels at Tor Sadaf continues throughout the time range of *ca*. 38–19,000 bp. Ahmarian technology and typology include core reduction techniques favouring the soft hammer and punch techniques, core rejuvenation strategies comprised of core tablets and 'platform blades' (described below), reduction emphasizing blade and bladelet production, and selection of elongated blanks for pointed tools. While technological strategies remain relatively stable, tool typologies are more variable, and pointed implements evolve into smaller point types. In order to gain a sense of how assemblages that occur at different sites and at different points in time might be related in a transgressive temporal sequence, Ahmarian technological and typological attributes are examined below. This is done in order to evaluate and monitor temporal continuity and change representing *ca*. 20,000 years in the sequence of assemblages in the al-Hasa area.

Core Reduction Strategies

Different reduction strategies have been attributed to the core technology of the Ahmarian technocomplex (Ferring 1980, 1988; Marks and Ferring 1988). Early Ahmarian core reduction has been described as a serial reduction strategy in which multiple interior products were produced successively from the same core, while Late Ahmarian reduction strategies are characterized as having multiple core reduction strategies (Ferring 1988:334). Core reduction in the al-Hasa Early Ahmarian assemblages reflects strong similarities in strategies to those described by Ferring (1988:342) for Early Ahmarian technology. The core assemblages exhibit a 'specialized' reduction strategy for the production of specific tools, such as points (*e.g*., el-Wad points) (Ferring 1988:342). Production of elongated non-cortical or interior blades and large bladelets appears to have been sequential as the core was reduced in size. Careful core preforming and the maintenance of core shape and core platforms are illustrated by distal trimming, platform edge abrasion, and elongated pyramidal shapes of discarded cores.

Late Ahmarian reduction strategies follow Ferring's (1988:343) description of multiple strategies, as well. Two reduction strategies are inferred in which large blade cores were used to produce large blades, as well as secondary core blanks. The latter were thick flakes and blades that could be used as secondary bladelet cores. There is ample evidence in the al-Hasa Late Ahmarian assemblages for small discarded bladelet cores made on thick flakes or blades. There is also evidence for large blade as well as large flake tools, produced from large cores, many of which exhibit substantial amounts of cortex reflecting an early stage in the reduction of large blanks.

What is important in core reduction strategies in the Hasa assemblages are the long-term continuities in some aspects of overall core reduction from the Early to Late Ahmarian. Similar reduction strategies are reflected in overall core morphology, size, and platform characteristics (Fig. 13.3). Core size and platform size reflect specific reduction strategies and are correlated with the size and shape of the debitage produced from the cores, although the size of discarded cores may reflect other factors as well, such as economizing behaviour and overall raw material availability. In the al-Hasa area, there is only a slight trend for discarded cores and platform areas to become somewhat smaller through time, as debitage becomes dominated by smaller blades and bladelets (Fig. 13.4). Nevertheless, the overall strategy of maintaining a sub-pyramidal shape for elongated blanks is reflected in the similar length to width ratios of cores. Early Ahmarian cores exhibit a L:W ratio of 1.92 (11.7 sd, n= 132), while Late Ahmarian cores are less elongated with a ratio of 1.82 (1.0 sd, n= 73). Overall core dimensions of Early and Late Ahmarian cores reflect long-term continuity in core reduction while the production goals shift to smaller blanks.

The use of 'cresting' or *lames à crête* as a preliminary blade core reduction technique is present but diminishes in Late Ahmarian assemblages (Fig. 13.5). In most cases, a relatively simple technique of setting up a core with an unfaceted platform was used, most likely as a result of the size and shape of raw material selected as cores. Based on abandoned cores, refitted cores, core tablets and tools made on core tablets, as well as successive refitted core tablets, the shape of many cores can be inferred to have been relatively thin, flat cortical nodules with a limestone cortex or rind. Rejuvenation of Ahmarian core platforms was dominated by the core tablet technique (Fig. 13.6), while removing a 'platform blade'[3] might have been a strategy for re-orienting a platform or initiating a new platform on the back of the core, usually at 90° to the original platform (Coinman 1997b:116;1998a:49). These transverse platform blades appear to be 'half-crested' because they exhibit a portion of the previous platform along one side of their main dorsal ridge but were struck from the back of the core's platform. This technique has been documented in other Ahmarian assemblages at sites in the southern Sinai at Abu Noshra II and in the central

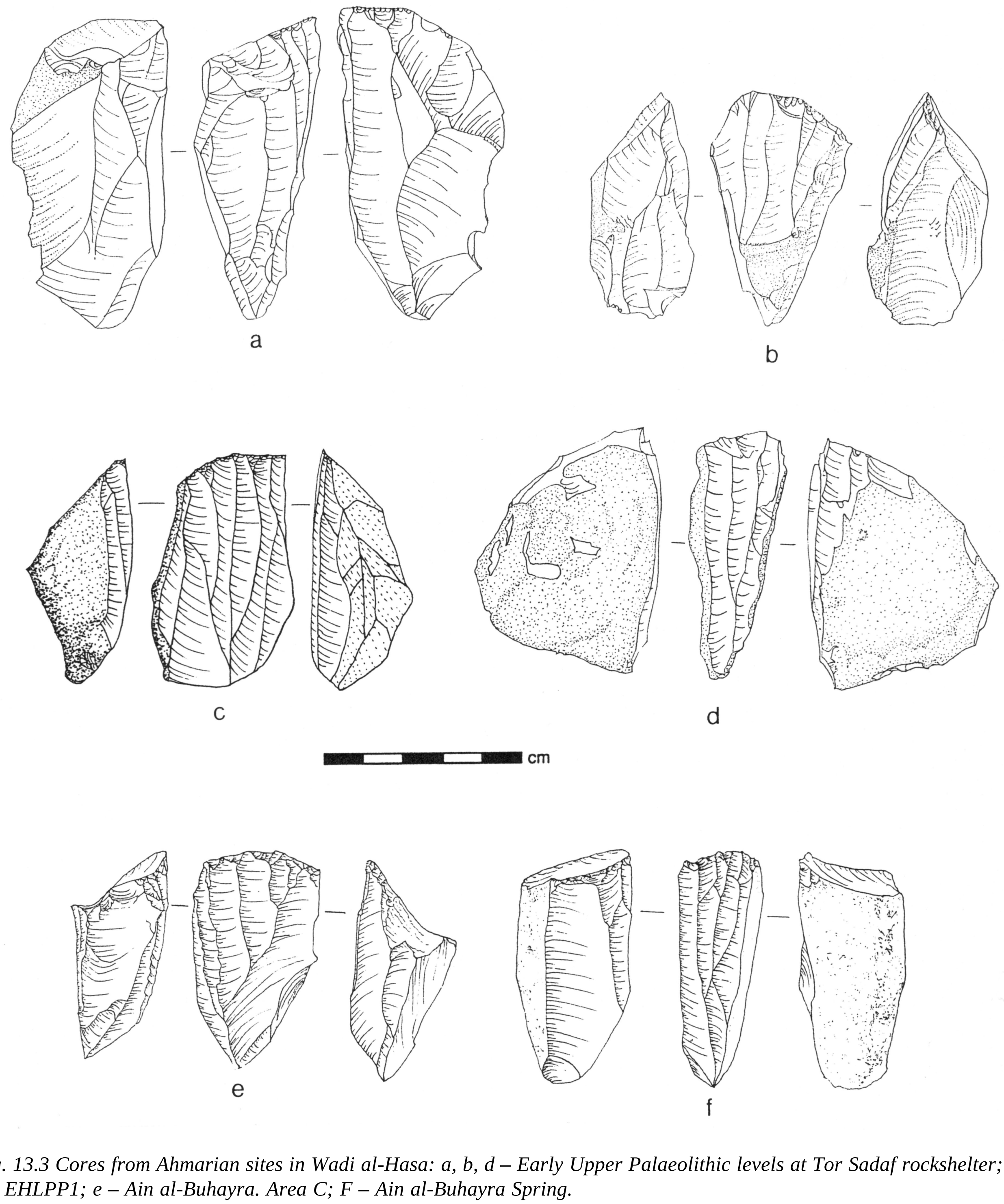


Fig. 13.3 Cores from Ahmarian sites in Wadi al-Hasa: a, b, d – Early Upper Palaeolithic levels at Tor Sadaf rockshelter; c – EHLPP1; e – Ain al-Buhayra. Area C; F – Ain al-Buhayra Spring.

Negev at Ein Aqev East (Ferring 1977:88, 1980:59; Coinman 1990:265), and in south Jordan at Tor Aeid, Tor Hamar, and Jebel Humeima (Coinman and Henry 1995:145,155,163,172). The long-term use of these technological techniques is demonstrated in their persistence at both Early and Late Ahmarian sites in the al-Hasa region.

Primary Core Reduction

Proportions of cores, core trimming elements (CTE), and primary cortical elements are strong indicators of on-site initial core reduction and can be used to reconstruct reduction sequences occurring at sites or missing segments of the sequence that may have occurred elsewhere. Primary cortical elements include debitage with approxi-

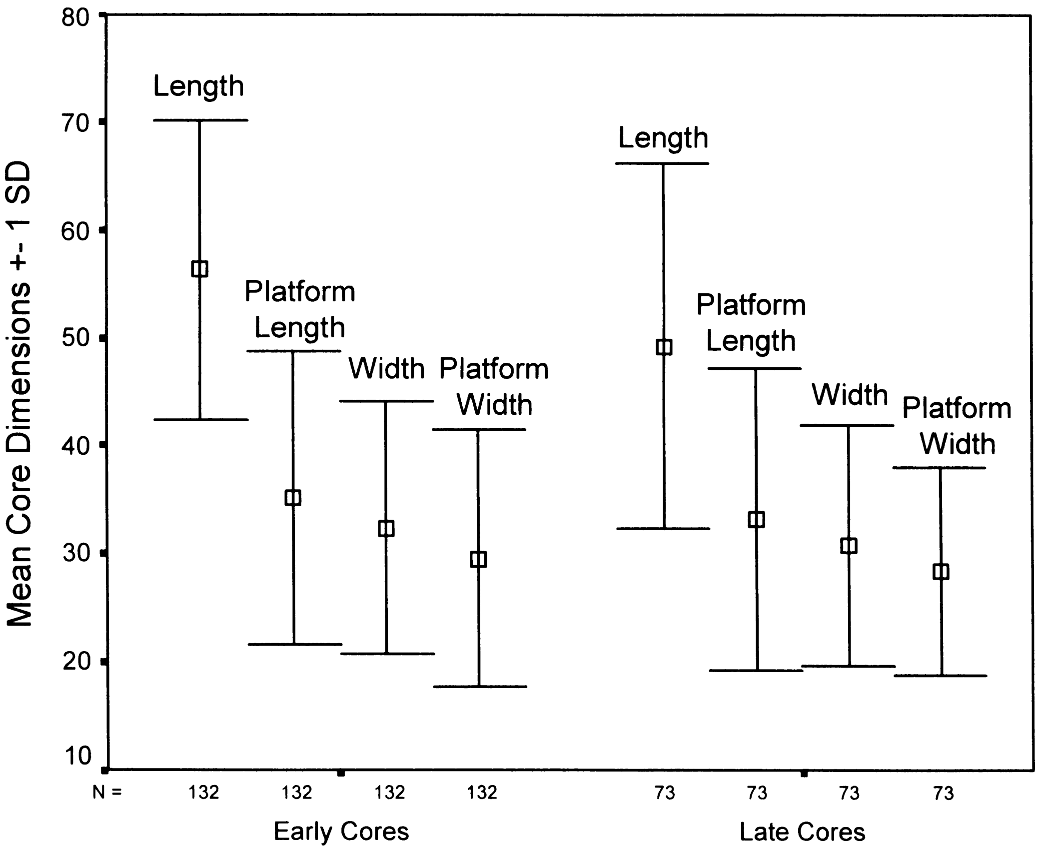


Fig. 13.4 Mean dimensions of cores from sites in Wadi al-Hasa. (Platform width = lateral width; Platform length = length from front face to back of platform)

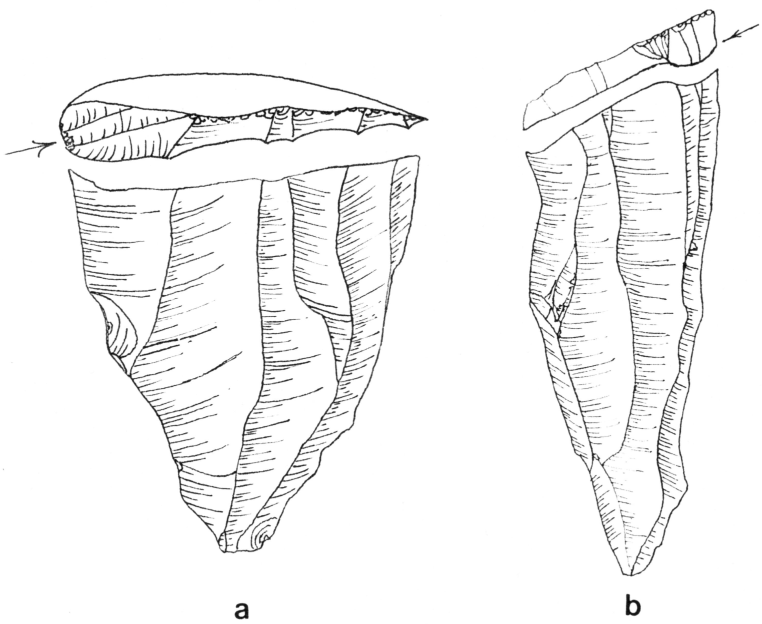


Fig. 13.5 Ahmarian core trimming and rejuvenation techniques: a) platform blade; b) core tablet.

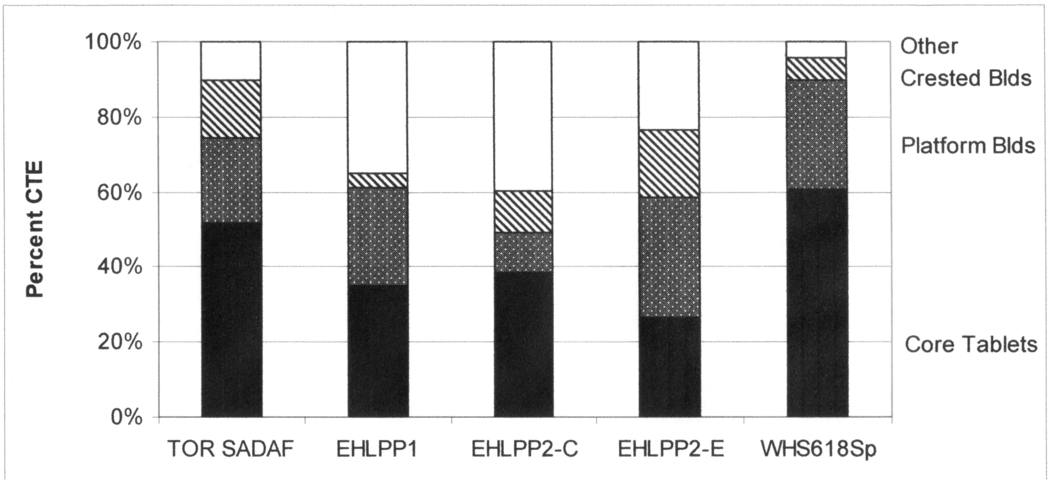


Fig. 13.6 Relative proportions of the predominant types of core trimming elements (CTE) in debitage assemblages at sites in Wadi al-Hasa.

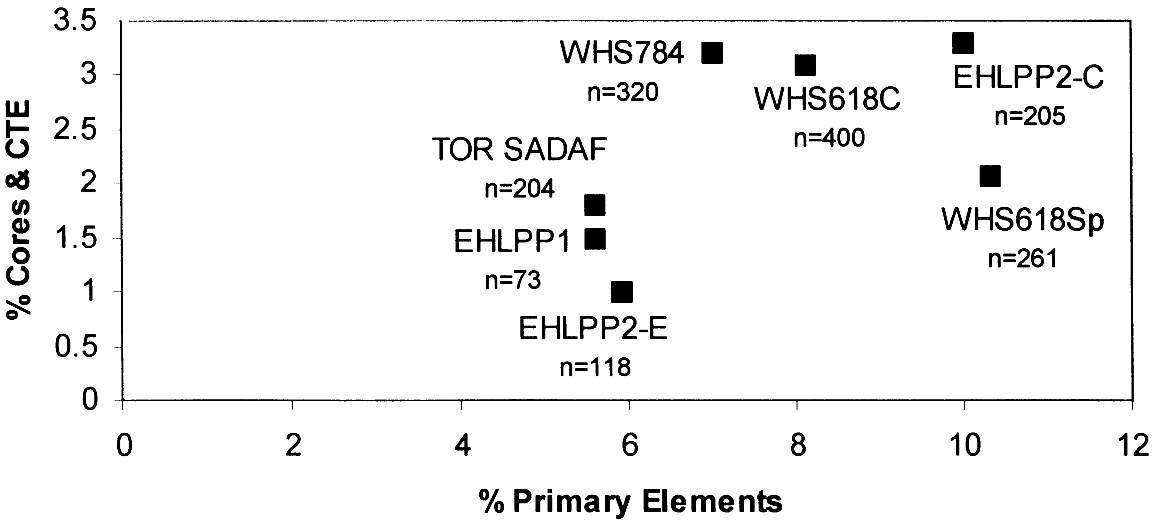


Fig. 13.7 Primary reduction elements at sites in Wadi al-Hasa. Primary elements are defined by at least 50% cortex.

mately 50% or more cortex. Comparisons of the relative proportions of initial stage reduction elements represented at Ahmarian sites in the al-Hasa area indicate important differences among the sites with at least two distinct site groupings (Fig. 13.7). The Early Ahmarian sites of Tor Sadaf, EHLPP1 and Thalab al-Buhayra, Locus E (EHLPP2-E) all exhibit relatively low intensity primary reduction activities with cores and core trimming elements ranging from 1.0–1.8% and primary elements represented by 5.6–5.9%. This contrasts with two Late Ahmarian sites – Yutil al-Hasa (WHS 784) and Ain al-Buhayra, Area C (WHS 618 C) – in which high frequencies of all initial stage reduction elements are present. The most dramatic differences among the sites are represented at the Early Ahmarian site of Thalab al-Buhayra, Locus C (EHLPP2-C) with the highest proportions of all primary reduction elements. The Late Ahmarian site of Ain al-Buhayra (WHS 618 Spring) contains equally large numbers of primary elements but lower proportions of cores and core trimming elements. For the most part, primary elements

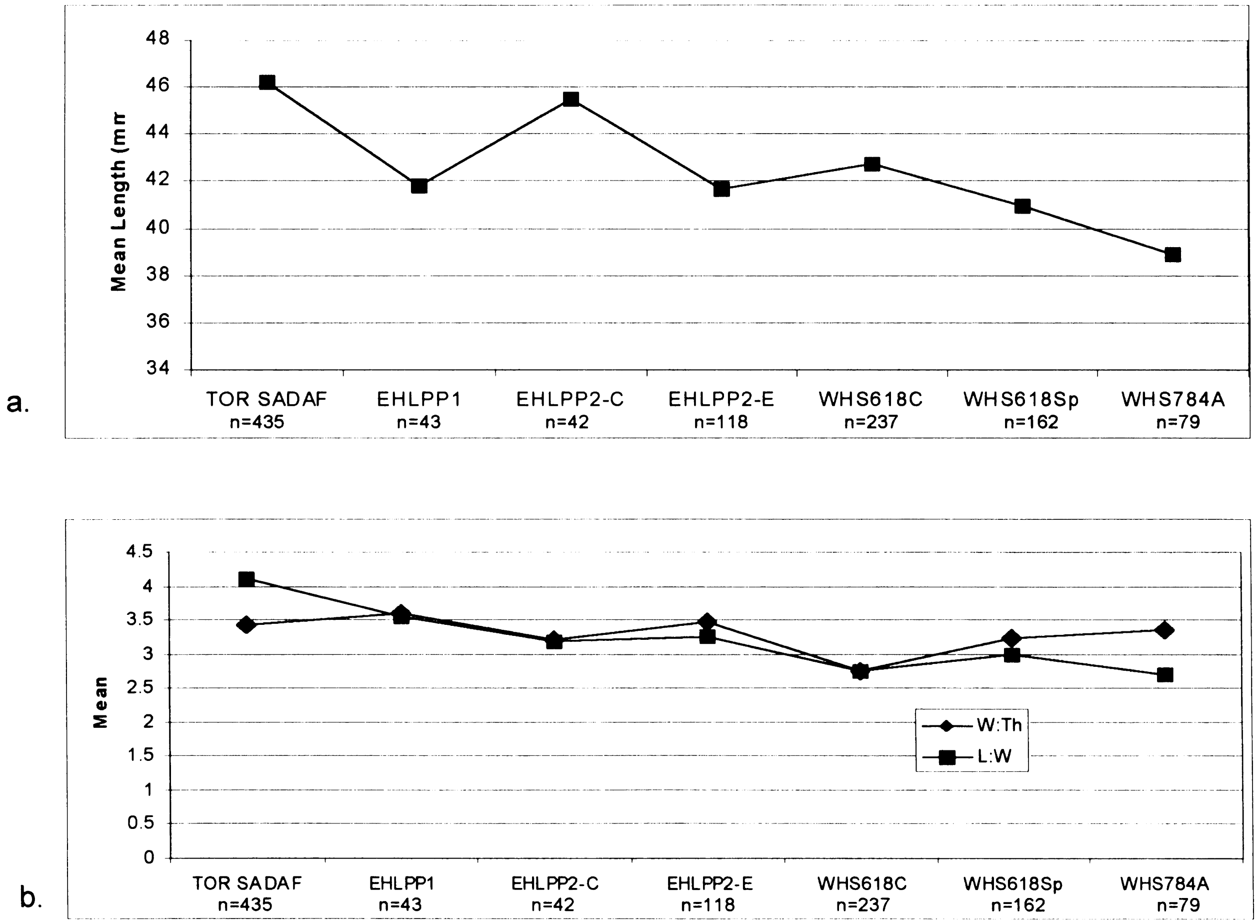


Fig. 13.8 Changing dimensions in blade/let debitage in Ahmarian sites in Wadi al-Hasa: a) length; b) ratios of length:width and width:thickness.

are cortical flakes rather than cortical blade/lets, and at EHLPP2-C, these are large primary flakes struck from very large cores with a mean of 64.9 mm (sd 9.85) on an initial sample of nine cores. When the debitage assemblages are restricted to relative proportions of flakes (excluding small trimming flakes) and blade/lets, flake debitage represents close to 50% or more of the restricted debitage assemblages: WHS 784 (73%), Thalab al-Buhayra (E-47.3%; C-54.4%), and WHS 618 Spring (48.9%). This is in spite of the fact that each of these assemblages has a well-developed blade and bladelet component. It emphasizes the importance of flake debitage as a primary indicator of on-site reduction activity rather than a diagnostic criterion of specific lithic cultural traditions.

Blade and Bladelet Debitage Production

In each of the Ahmarian assemblages in the Hasa blades and bladelets comprise a significant subset of blank production. The mean size of blade-like debitage decreases through time as production shifts to smaller debitage (Fig. 13.8a). Bladelets become shorter but less elongated. Early Ahmarian bladelets at Tor Sadaf and EHLPP1 are the most elongated with mean length:width ratios of 4.0 and 3.5, respectively (Fig. 13.8b). The diminutive size of debitage platforms in assemblages throughout the temporal range of the Ahmarian in the al-Hasa area suggests that Ahmarian blade technology most likely emphasizes an indirect punch technique rather than soft hammer to remove blades and bladelets with such small platforms (Fig. 13.9a, b). Interestingly, the lateral widths[4] of platforms are the smallest on the longest bladelets, as reflected in the extremely small platforms on bladelets from Tor Sadaf that average only 2.5 mm in width. Platform width increases by Late Ahmarian times, while thickness remains relatively stable at approximately 1 mm.

Blank Production and Tool Selection

Elongated blanks in Ahmarian assemblages were produced and used primarily for pointed implements made on the small blades and bladelets. Initially, the emphasis

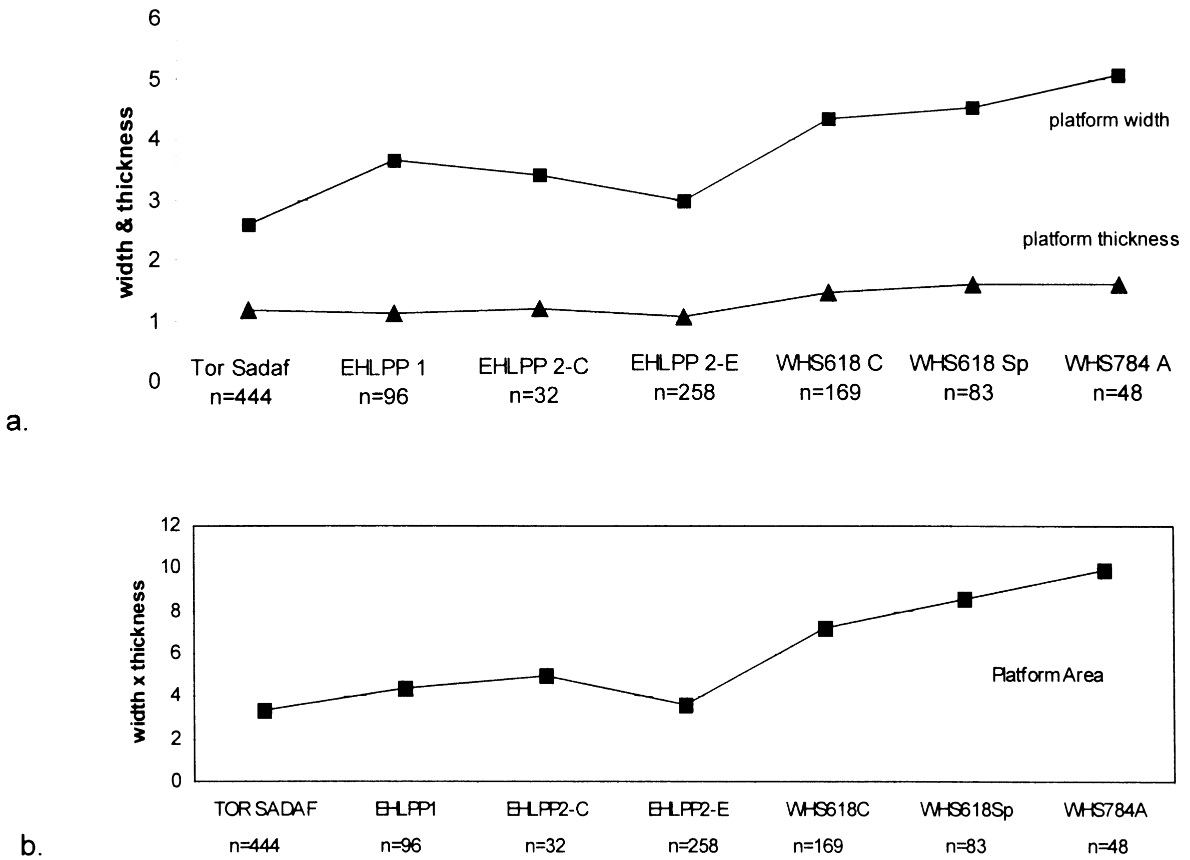


Fig. 13.9 Dimensional change in bladelet platform technology associated with punch technique: a) platform width and thickness; b) platform area (width x thickness).

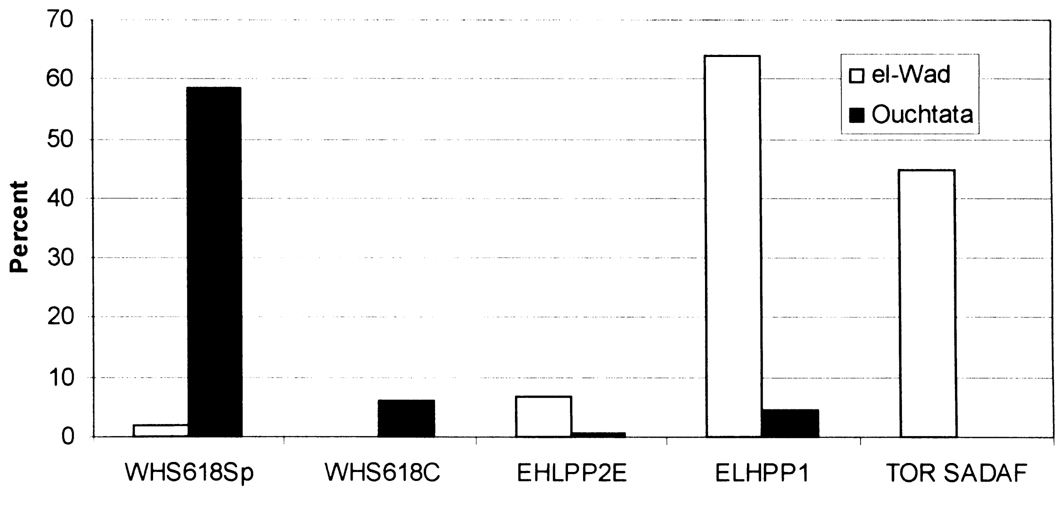


Fig. 13.10 Changing frequencies of pointed tools – el-Wad points and Ouchtata points – in Ahmarian sites in Wadi al-Hasa.

Table 13.2 Cross-tabulation of retouch attributes on el-Wad points from Tor Sadaf (n= 152) and EHLPP1 (n= 52).

Retouch Placement		Retouch Location Both	Left	Right	Total
Alternating	Count		2	1	3
	% of Total		1.0%	0.5%	1.5%
Inverse	Count	3	11	25	39
	% of Total	1.5%	5.4%	12.3%	19.1%
Obverse	Count	51	23	68	142
	% of Total	25.0%	11.3%	33.3%	69.6%
Alternate	Count	19		1	20
	% of Total	9.3%		0.5%	9.8%
Total	Count	73	36	95	204
	% of Total	35.8%	17.6%	46.6%	100.0%

Retouch placement = face or faces of a blank (Marks 1976c:376)
Retouch location = lateral edges
Alternate = inverse and obverse retouch on different lateral edges (Marks 1976c:376)
Alternating = inverse and obverse retouch alternating along the same edge (Marks 1976c:376)

Table 13.3 Cross-tabulation of Retouch Attributes on Ouchtata Bladelets and Points from Ain al-Buhayra (WHS618) Area C, n= 57; Spring, n= 390.

Retouch Placement		Retouch Location Both	Left	Right	Total
Alternating	Count	19			19
	% of Total	4.3%			4.3%
Inverse	Count	2	3	16	21
	% of Total	0.4%	0.7%	3.6%	4.7%
Obverse	Count	71	18	289	378
	% of Total	15.9%	4.0%	64.7%	84.6%
Alternate	Count	29			29
	% of Total	6.5%			6.5%
Total	Count	121	21	305	447
	% of Total	27.1%	4.7%	68.2%	100.0%

Retouch placement = face or faces of a blank (Marks 1976c:376)
Retouch location = lateral edges
Alternate = inverse and obverse retouch on different lateral edges (Marks 1976c:376)
Alternating = inverse and obverse retouch alternating along the same edge (Marks 1976c:376).

was on producing a variety of el-Wad point types and later on the more narrow Ouchtata points that have been found primarily at Ain al-Buhayra and Yutil al-Hasa (Fig. 13.10). This is supported by the size and facet dimensions of discarded cores. Typological differences between early and late stages are limited, with the most important tool differences represented by differences in the amount, placement (face), location (edge), and type of retouch used to shape blade/lets into el-Wad points (Table 13.2). The earlier el-Wad points exhibit abrupt to semi-abrupt retouch along the lateral edges, often grading into a finer, less steep retouch around the distal tips (Fig. 13.11). Correlation between the location of retouch and the placement of retouch shows that the el-Wad points tend to exhibit retouch on both edges, often by inverse retouch (19.1%), but more commonly as obverse retouch (69.6%). Retouch on both edges or alternating inverse/obverse retouch along the same edge is less frequent.

By the Late Ahmarian, retouch on bladelets and points had become more standardized and occurred predominantly on the right obverse edge (64.7%), while inverse retouch is found only rarely (Fig. 13.12 and Table 13.3). Retouch on proximal areas tends to square off the proximal ends of Ouchtata points and bladelets. There are fewer examples of deliberate retouch to shape distal ends into retouched points amongst the Ouchtata pieces.

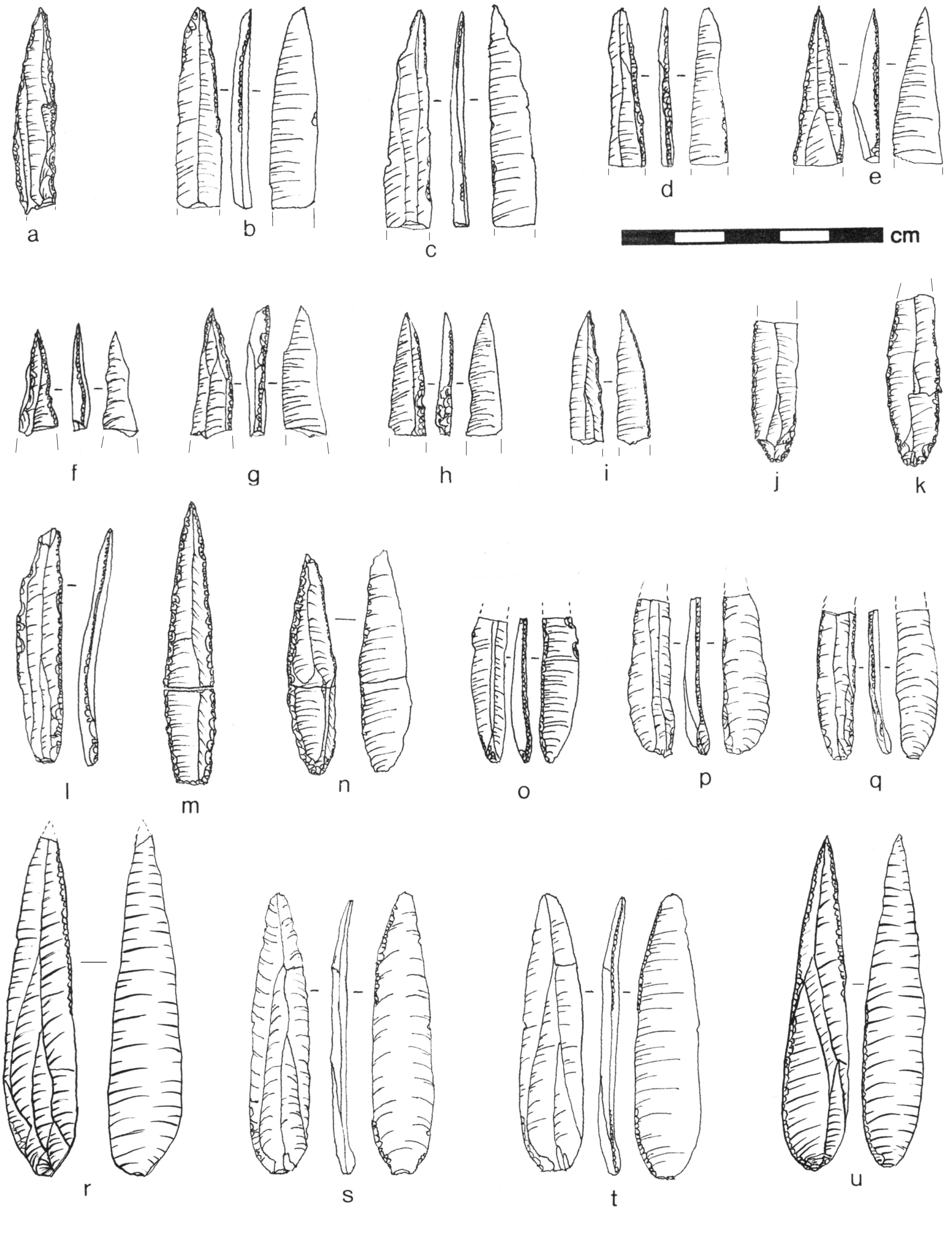


Fig. 13.11 El-Wad points from Early Ahmarian sites: b – d, l, p, q, s, t – Tor Sadaf; e-h, o – EHLPP 1; a, i-k, m, n, r – Thalab al-Buhayra (EHLPP 2); u – Ain al-Buhayra (WHS 618), Early Upper Palaeolithic surface material, northern area of site.

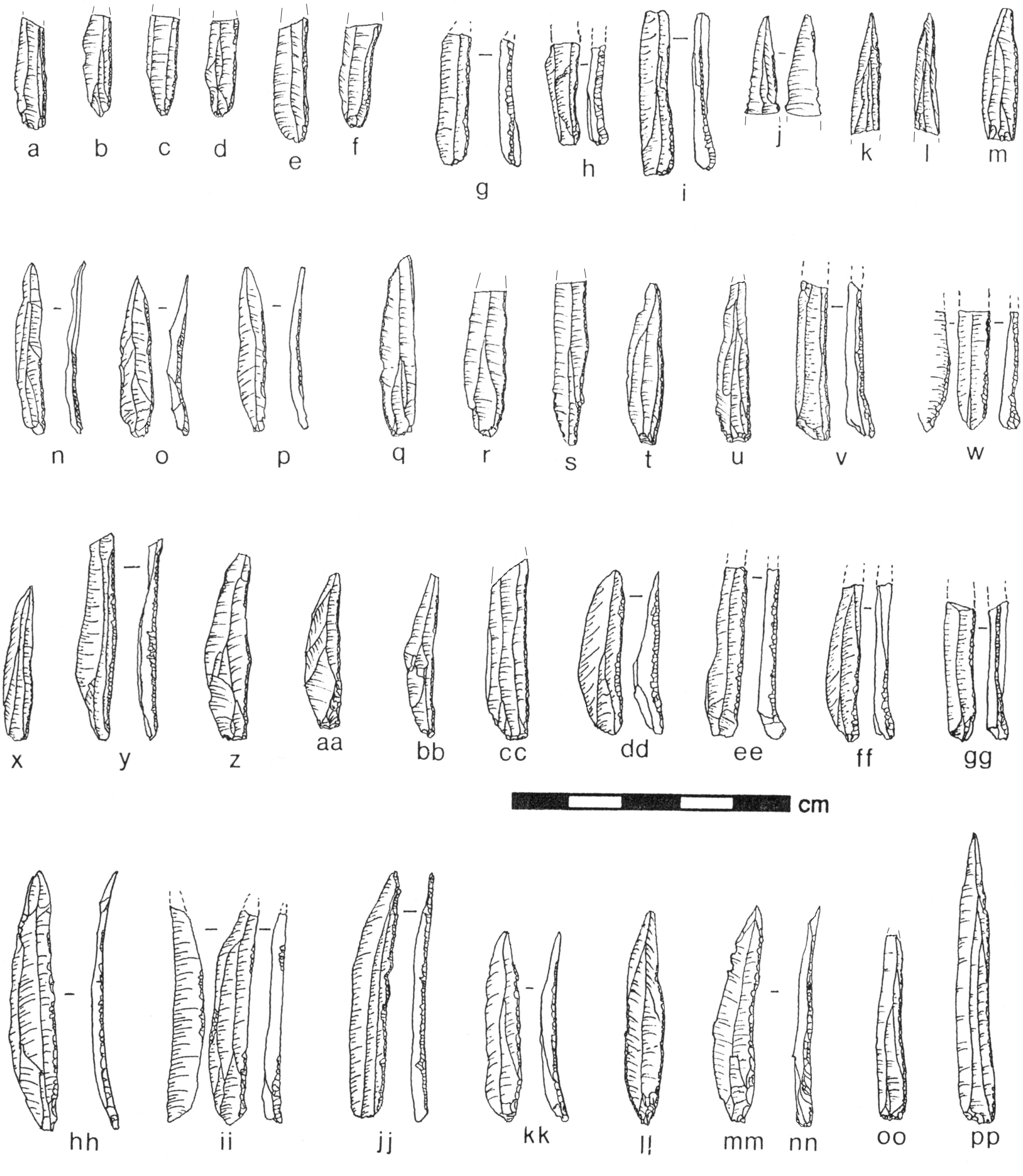


Fig. 13.12 Ouchtata points and bladelets with Ouchtata retouch from Ain al-Buhayra (WHS 618) Spring area.

Complete Ouchtata points and distal fragments, however, indicate that most pieces were naturally pointed. Although some pointed tool types have been defined precisely on the basis of deliberate retouching to form a point, others have not (*e.g.*, Levallois points). Whether we type these pointed implements as specific point types or type them as retouched and partially backed blades/bladelets, they remain 'pointed' implements that contrast sharply in retouch and morphology with the more standardized backed and truncated microliths that are typically found in Early Epipalaeolithic assemblages.

The preponderance of similarities in retouch placement, location, and style between complete el-Wad points and Ouchtata points and their associated fragments argues

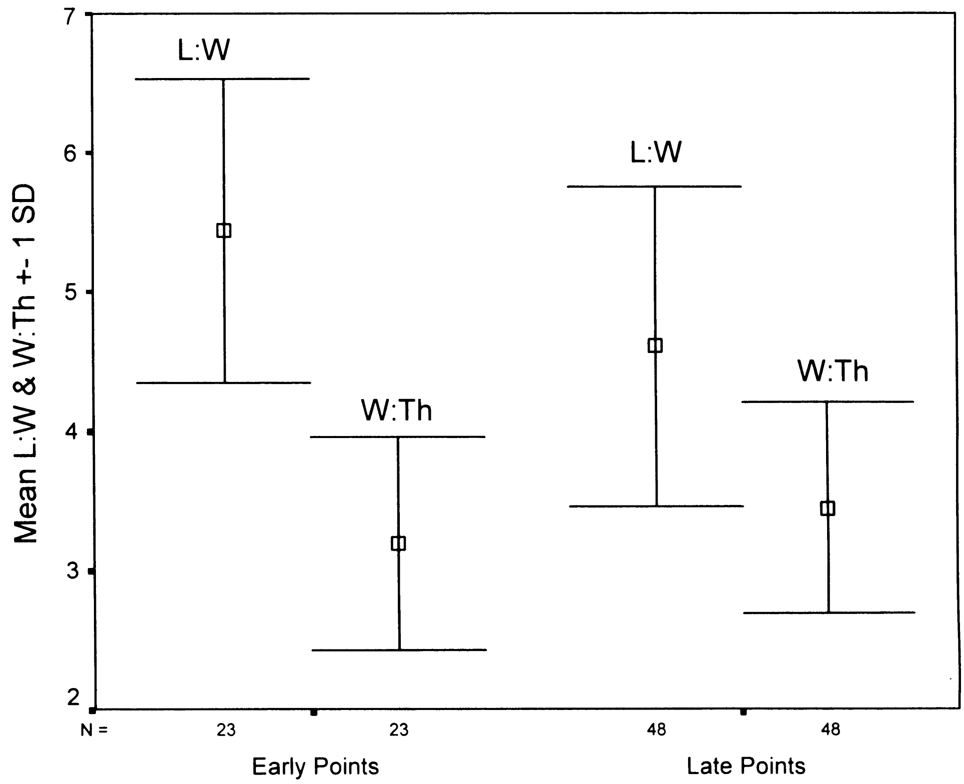


Fig. 13.13 Mean length to width and width to thickness ratios of Early and Late Ahmarian points from sites in Wadi al-Hasa.

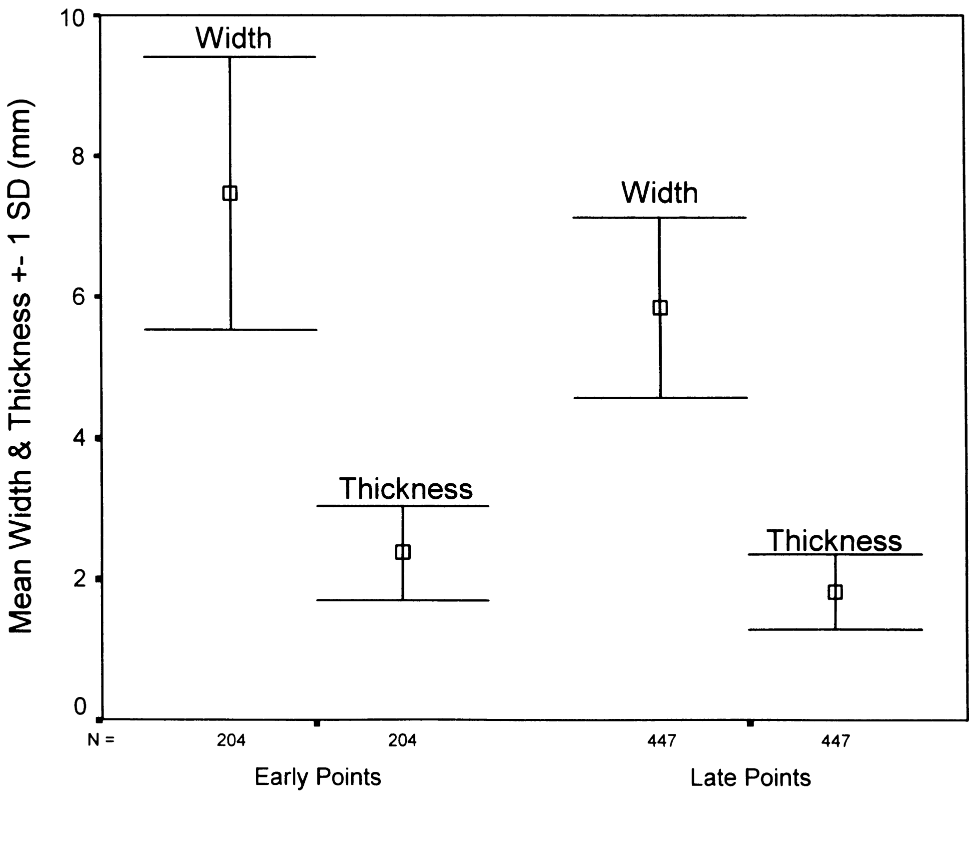


Fig. 13.14 Mean width and thickness dimensions of Early and Late Ahmarian points in Wadi al-Hasa.

Table 13.4 Dimensional Attributes of el-Wad Points from Early Ahmarian Tor Sadaf and EHLPP 1 and Ouchtata Points at Late Ahmarian Ain al-Buhayra.

Tor Sadaf el-Wad Points	Length	Width	Thickness	L:W Ratio	W:Th Ratio
n	20	152	152	20	152
mean	43.63	7.02	2.22	5.5	3.26
sd	9.69	1.51	0.54	1.08	0.73
EHLPP1 el-Wad Points					
n	3	52	52	3	
mean	42.1	8.79	2.79	5.03	3.29
sd	14.3	2.41	0.83	1.29	0.96
Ain al-Buhayra Ouchtata Points					
n	48	447	447	48	447
mean	27.59	5.85	1.81	4.6	3.36
sd	6.9	1.28	0.51	1.15	0.82

strongly for a typological and functional relationship between the two point types as one type appears to evolve into the other. Limited use-wear or microwear studies have been completed on these tools, but Williams (1997a) has provided convincing evidence that el-Wad points from the Early Ahmarian rockshelter site of Tor Aeid (J432) were used as projectiles, as well as for other functions. Becker (1999, herein) indicates that many el-Wad points at Abu Noshra were used as perforating tools. The shape and symmetry of el-Wad points suggest their primary functions were as projectiles. There have been no comparable microwear studies on the Ouchtata bladelets, and, therefore, attributing an analogous projectile function is inferred on the basis of techno-typological similarities to the el-Wad points. Other than size, there are no technological and few typological differences between el-Wad points and Ouchtata points when the al-Hasa data are compared to each other so that variability in some aspects of retouch and size might be the only distinguishing characteristic. El-Wad points average 42 mm in length, while Ouchtata points have a mean of about 27 mm (Table 13.4). Length to width ratios vary slightly between the two groups of points (Fig. 13.13) with el-Wad points exhibiting greater elongation. Width to thickness ratios, however, are relatively close. Mean blank thickness is very similar for both types, and variability in mean blank width is the only attribute that reflects overall differences in size (Fig. 13.14). The end result is a smaller, less elegant, less formal ‘point’. Some of the retouch varies between the two groups of artefacts. Perhaps the differences in retouch type and intensity might be a function of the variation in the thickness of blanks. Ouchtata retouch, by definition, occurs along edges of small, very thin bladelets and consists of retouch that grades from fine retouch to extremely minute alteration of an edge (Marks 1976c:377, after Tixier 1963:40). Thus, as overall blank size decreases, some of the retouch changes in response to thinner bladelets, but the final tool maintains the overall shape of a pointed implement.

Variability in Ahmarian Tool Kits

Although the primary emphasis in Ahmarian assemblages appears to be on elongated blanks for the production of pointed tools, typical Upper Palaeolithic tools were made on relatively large blanks throughout the Upper Palaeolithic. Ferring (1988:343) considers the production of large tools during the Early Ahmarian to be expedient and to be made on by-products of core preforming and maintenance during the initial stages of serial core reduction. He emphasizes that the Early Ahmarian specialized reduction strategy was aimed primarily at interior elongated blanks (Ferring 1988:342), but evidence from at least one site in the al-Hasa indicates that large cortical flake tools were most likely of primary importance in activities carried out at the site. During the Late Ahmarian, according to Ferring, there are divergent large tool requirements that result in multiple reduction strategies. Large tools are suggested to be made intentionally as part of one strategy involving large blade cores and separate from the production of small bladelets. In the al-Hasa area, there are two contrasting groups of Ahmarian sites in which larger tools are offset by smaller, more specialized tools. Scrapers, burins, and truncations make up the most important categories of large tools, while points and retouched bladelets represent special tools (Fig. 13.15). The most striking distributions are found again at Thalab al-Buhayra, Locus C (EHLPP 2-C), where scrapers of a wide variety outnumber all other tool categories (42.2%), while the other sites exhibit proportions of scrapers that are generally less than 20%. Burins are insignificant in all but two sites – the Late Ahmarian sites of Ain al-Buhayra (WHS 618 C) and Yutil al-Hasa (WHS 784). Scrapers at Locus C in Thalab al-

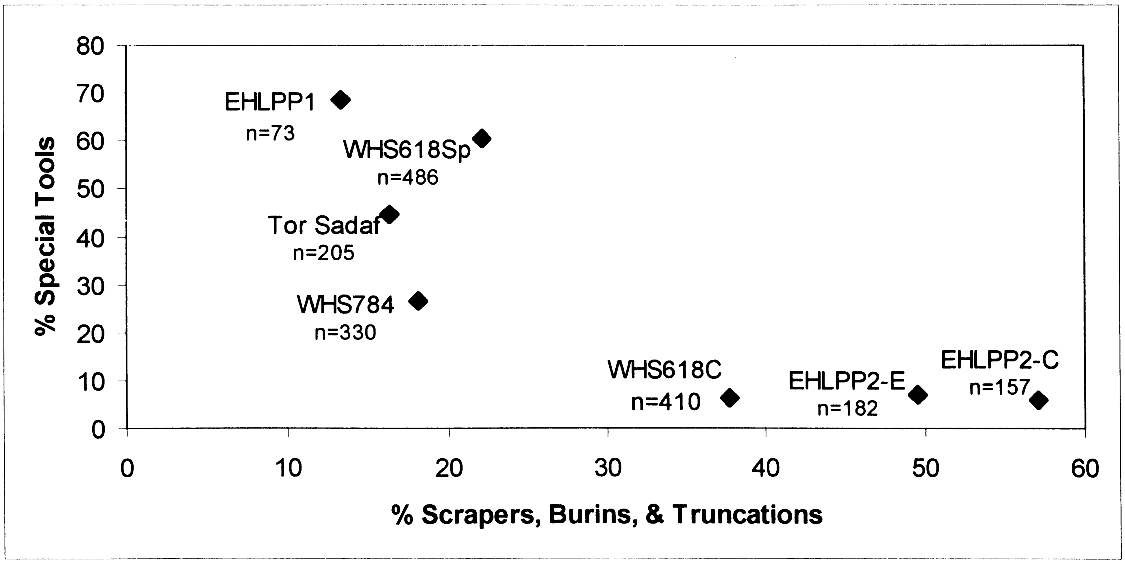


Fig. 13.15 Tool composition at sites in Wadi al-Hasa (percentages). Special tools are defined as el-Wad points and Ouchtata points and bladelets.

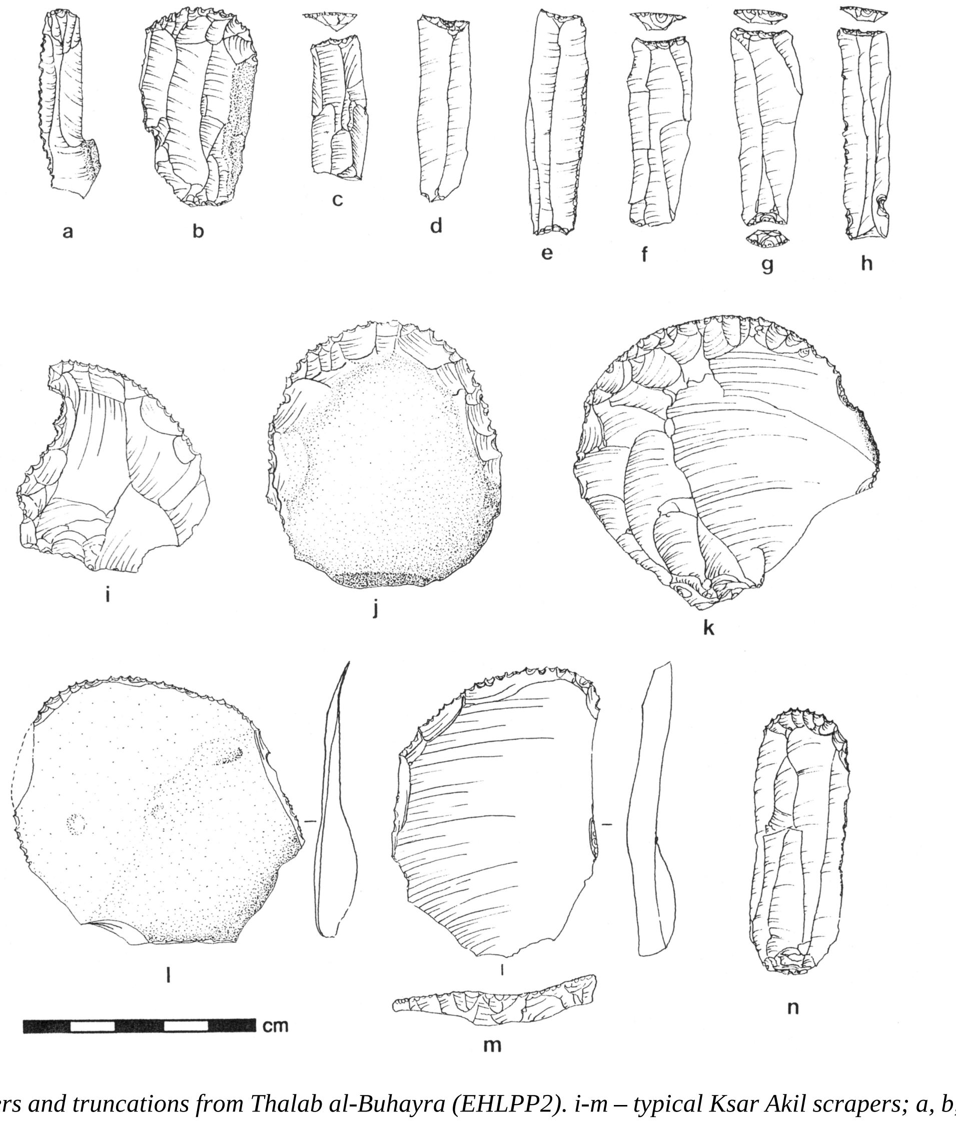


Fig. 13.16 Scrapers and truncations from Thalab al-Buhayra (EHLPP2). i-m – typical Ksar Akil scrapers; a, b, n – atypical micro-serrated tools; c, d, f, h – truncations; e, g – double truncations.

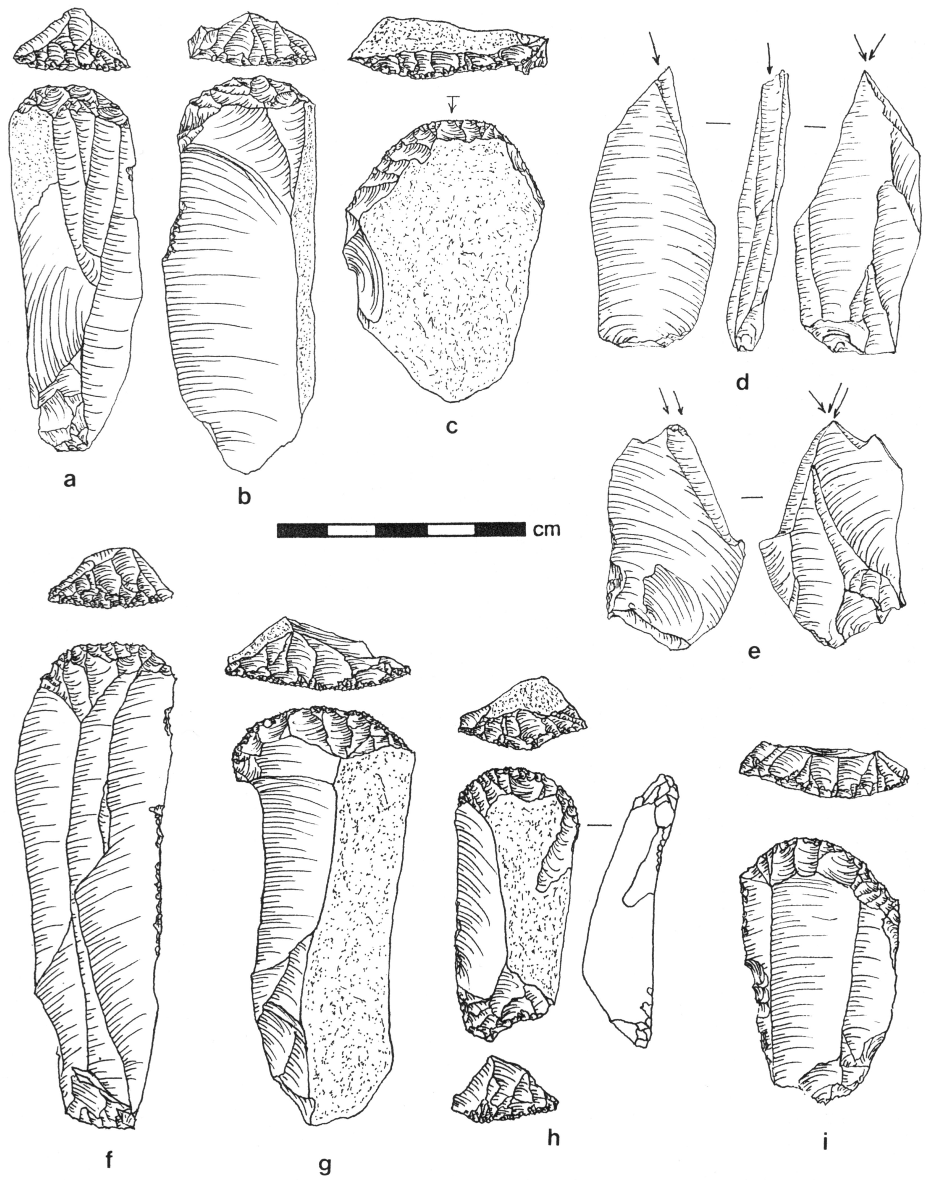


Fig. 13.17 Large tools from Ain al-Buhayra (WHS 618): a, e, h, i – Area C; b - d, f, g –Spring.

Buhayra include narrow endscrapers, as well as micro-serrated endscrapers and Ksar Akil flake scrapers (Besançon *et al*. 1975–7), which are found in the same context as primary reduction elements. Many of the scrapers were made on cortical flakes. Closely associated with the scrapers at this site are truncations, forming an unusual toolkit (Fig. 13.16). The combination of truncations and scrapers is strikingly similar to that recovered from Level 5 at Boker BE in the central Negev (Jones *et al*. 1983), although the latter has a much higher frequency of el-Wad points. The two sites date to approximately the same time range *ca*. 27–25,000 bp (Marks 1983b:37). The tool kit at nearby Locus E at Thalab al-Buhayra is similar in makeup to the Locus C tool kit, but scrapers and truncations occur in more equal proportions. Area C at Ain al-Buhayra (WHS 618) has an interesting mix of relatively more truncations, the highest percentage of burins, but significantly fewer scrapers (Fig. 13.17).

Assemblages that are dominated by more specialized blade and bladelet tools have been recovered from both Early and Late Ahmarian sites. These are Tor Sadaf, EHLPP 1, the Spring area of Ain al-Buhayra (WHS 618 Spring), and Yutil al-Hasa (WHS 784), in which various sized pointed implements and finely retouched bladelets comprise significant proportions of their respective assemblages. Tor Sadaf and EHLPP 1, a rockshelter site and an open-air site, respectively, are dominated by el-Wad points and exhibit relatively lower primary reduction elements. Projectile point production or retooling activities might best describe activities at these sites. Major

proportions of finely retouched bladelets, many of which are the small Ouchtata points (or fragments of such points) have been recovered from the Late Ahmarian sites of Ain al-Buhayra Spring Area, and Yutil al-Hasa (WHS 784) rockshelter. Primary reduction elements are significantly higher than at the other sites (see Fig. 13.7).

In summary, the Ahmarian sites exhibit well-patterned differences in tool kits that are most likely associated with different activities or a different range of activities that occurred at these sites, and where on- and off-site reduction activities obviously varied. Since large tools occur in varying proportions at both Early and Late Ahmarian sites and many have been made on primary elements, the reduction strategies appear to vary according to specific activities that were carried out at site. In the case of Thalab al-Buhayra (Locus C), interior blades and bladelets which would be predicted to be the primary focus of Early Ahmarian specialized reduction strategies were produced but in smaller quantities than flake debitage, especially cortical flake debitage. Many of these were used for large tools, as well as potentially large numbers of utilized flakes that were not formally retouched. If interior blades and bladelets were needed for pointed tools, they were not left at the site or at this area of the site. Rather, activities appear to have revolved around the larger tools – the scrapers and truncations, which were discarded in large numbers. A current study of flakes, both retouched tools and utilized flakes, is on-going and should help identify more specifically the on-site activities that required an emphasis on expedient large tools rather than the specialized tools made on interior products that are predicted in Ferring's reduction models.

Conclusions

Examination of the debitage and tool assemblages in the al-Hasa area illustrates a long chronological sequence of evolving Ahmarian technology and variable typologies at rockshelters and open-air sites. Ahmarian sites in the al-Hasa basin exhibit specific technological and typological trends during the period from *ca*. 40–19,000 bp that place this series of sites squarely within the Ahmarian. The al-Hasa region techno-typological sequence is comprised of full-fledged Upper Palaeolithic Ahmarian blade core reduction, but some assemblages exhibit characteristics, such as flake-dominated debitage and tools, that often have been attributed to the Levantine Aurignacian (*e.g.*, Gilead 1981a, Marks 1981a). These include varying proportions of large tools and debitage and a heavy emphasis on flakes, although these are found in conjunction with well-executed blade and bladelet components. Blank production and selection in these assemblages were directed at both large and small tools. Larger tools consisted of the classic Upper Palaeolithic tool types, such as endscrapers, burins, and truncations. These occur in variable proportions at sites in the al-Hasa basin, and they occur in both Early and Late Ahmarian assemblages but may be strongly associated with specific activities at some sites. Smaller tools consisting of specialized pointed implements, either el-Wad point varieties or Ouchtata points and bladelets, dominate tool composition in some Early and Late Ahmarian sites, as well. Late Upper Palaeolithic pointed tools that are found after 25,000 bp, however, are typically smaller than earlier points. After about 22,000 bp in the al-Hasa area, some of the early Epipalaeolithic sites or occupation levels overlap temporally with Late Ahmarian occupations. Low numbers of early Epipalaeolithic microliths and the microburin technique occur at the same time that Late Ahmarian Ouchtata bladelets are the predominant form of retouched bladelets at other sites (see Olszewski herein; al-Nahar 2000). At a number of other late Pleistocene sites in the Levant, Ouchtata bladelets in varying numbers occur in the same assemblages with typically Early Epipalaeolithic backed microliths. These sites – Azariq XIII, Shunera XVI, Ohalo II, Fazael X, and Masraq en-Naj – have been included in the Masraqan, which has been defined as Early Epipalaeolithic (Goring-Morris and Belfer-Cohen 1997). Since all of these assemblages have clearly overlapping assemblages of retouched bladelets, they are both late Upper Palaeolithic and Early Epipalaeolithic in their typologies. Two other sites – Ain al-Buhayra (WHS 618) and Ein Aqev East (Ferring 1997) – have been included in the Masraqan, but their inclusion in the Masraqan is more tenuous. Neither of these two sites contains an assemblage of Epipalaeolithic microliths. Rather, both sites are dominated almost exclusively by bladelets with Ouchtata retouch and they share remarkable technological and typological similarities (Coinman 1990, 1993). In that respect, they fall more appropriately in the Late Ahmarian technocomplex (Ferring 1977, 1980, 1988; Marks and Ferring 1988).

The lithic assemblages from the al-Hasa area, when examined within a technological framework focused on reduction strategies suggest that differential proportions of tool types and subsets of debitage at Upper Palaeolithic sites are most likely a result of different on-site activities and thus, potentially different site functions. Furthermore, specific intra-site activities may have changed at some sites during different occupation periods within large, multi-component sites. Ongoing research of the Wadi al-Hasa assemblages seeks to define more clearly the articulation of technology with subsistence strategies at sites that exhibit a variety of intra-site lithic and faunal configurations within different site settings and preservation contexts. By focusing on a constellation of artefact assemblages and site features, we are able to move beyond the systematics of the Levantine Upper Palaeolithic and direct our attention at trying to understand larger issues of adaptive responses during the late Pleistocene when settlement and subsistence strategies were changing. Many of these were changes in human subsistence strategies associated with the exploitation of new varieties of plants and animals. At present, those

changing strategies are only partially documented and incompletely understood.

Acknowledgements

Research at sites in the Wadi al-Hasa has been conducted with the permission of the Department of Antiquities of Jordan, which has provided continued support over the course of many years, and for which we are all most grateful. Research on the Palaeolithic of the al-Hasa region under the aegis of the Wadi Hasa Palaeolithic Project (WHPP) and the Wadi Hasa North Bank Survey (WHNBS), 1984–93, was directed by G.A. Clark (Arizona State University) and supported by grants from the National Science Foundation, the National Geographic Society, and Arizona State University. Research by the Eastern Hasa Late Pleistocene Project (EHLPP), directed by D.I. Olszewski (Bishop Museum) and N.R. Coinman (Iowa State University), 1997, 1998 and 2000 has received primary funding from the National Science Foundation (SBR 9618766), the Wenner-Gren Foundation for Anthropological Research (Gr. 6278), the National Geographic Society (Gr. 6695–00), the United States Information Agency (USIA), the American Center of Oriental Research (ACOR) in Amman, the Joukowsky Family Foundation, and the Graduate College and Department of Anthropology at Iowa State University. While in Jordan, ACOR and its staff have provided logistical support. This chapter has benefited from the helpful comments and suggestions of several reviewers. This is EHLPP Contribution #17.

Notes

1 The sample has been identified in previous publications as 'spring/tufa sediments' (Clark *et al*. 1987:40; Schuldenrein and Clark 1994:34) but might more accurately be described as 'charcoal in tufa/marl sediments' since the sediments come from a culturally-derived feature rather than a sterile tufa or lacustrine context.

2 The designations for the transitional occupation periods at Tor Sadaf replace the initial designation – 'Transitional A' and 'Transitional B' that were used in Coinman and Fox (2000) and Fox and Coinman (2000).

3 Reference to these core trimming elements was made in Coinman (1990:265) after observing them in assemblages from Abu Noshra, Ein Aqev, and Ein Aqev East. Subsequently, they were noted in other Ahmarian assemblages in the al-Hasa area and south Jordan (Coinman and Henry 1995:145). Most recently they were noted by the author on two refitted cores from Azariq XIII, a late Upper Palaeolithic/early Epipalaeolithic site in the western Negev, also classified as Masraqan (Goring-Morris and Belfer-Cohen 1997). They are only half-crested with the 'crest' comprised of a portion of the lateral edge of the core's platform. They were struck from the back of the core rather than the front face of the core, where a removal might include a front ridge(s) and 'cresting' representing distal trimming on the distal end of the core. The latter type of trimming element has been documented in the Early Ahmarian assemblage at Tor Sadaf and is included in the category of crested blades.

4 The 'width' of a platform represents a lateral measurement of the platform similar to the lateral width of a blank (side to side), while the 'thickness' is similar to that for a blank and is measured between the dorsal to ventral sides. Both measurements follow Ferring (1980:81), Dibble (1987:113), Andrefsky (1998:93), and Shott (1986:40) among others.

14. Tor Fawaz (J403): An Upper Palaeolithic Occupation in the Jebel Qalkha Area, Southwest Jordan

Kristopher W. Kerry and Donald O. Henry

Introduction

In the course of surveys conducted in the Jebel Qalkha area of southwest Jordan during the late 1970s and early 1980s numerous prehistoric sites were discovered (Fig. 14.1). Subsequent excavations uncovered sites representing Middle, Upper, and Epi-Palaeolithic occupations (Henry 1982, 1986, 1988, 1995a). While many of the assemblages fit well within existing taxonomic frameworks, the Upper Palaeolithic assemblage from Tor Fawaz (J403) resists concrete taxonomic placement. The assemblage from Tor Fawaz and that from a second Upper Palaeolithic site, Jebel Humeima (J412), were initially described as Levantine Aurignacian (Henry 1982, 1986, 1988; Coinman 1990). Further description of these assemblages deemed them 'non-Ahmarian,' only loosely fitting criteria for the Levantine Aurignacian (Coinman and Henry 1995:194). In 1994 expanded excavation areas and deeper soundings at both sites enlarged the Upper Palaeolithic assemblages and also revealed underlying Levantine Mousterian horizons. While the much larger Upper Palaeolithic assemblage from Jebel Humeima revealed an unmistakable Early Ahmarian character (Kerry 1997a, b, 2000), the enlarged Upper Palaeolithic assemblage from Tor Fawaz remains taxonomically ambiguous, not corresponding to either Levantine Aurignacian or Ahmarian techno-typological parameters as currently defined.

Difficulty in the identification and description of Upper Palaeolithic assemblages, particularly from the southern Levant, is a recognized problem. As the number of surveyed sites and excavated assemblages increases, so does the level of variability recognized for the Upper Palaeolithic. Much of this variability is related to the dichotomous nature of the Levantine Aurignacian and Early Ahmarian classification in the context of environment (Mediterranean woodlands versus more arid desertic areas), site settings (stratified rockshelters as opposed to open-air sites), and technological objectives (flake-based versus blade-bladelet assemblages) (Coinman 1998a). Interpretations concerning variability and site function centre on the premise that the Levantine Aurignacian developed as an adaptive strategy exploiting the Mediterranean woodland zone of the central Levant. By contrast Early Ahmarian adaptive strategies are linked to the arid ecological conditions prevalent in the southern Levant (Bergman 1988b; Kaufman 1988, 1998; Phillips 1994; Coinman and Henry 1995; Coinman 1997a; Gladfelter 1997).

While the Levantine Aurignacian is seen as encompassing significant chronological variability in the Mediterranean woodlands of the northern and central Levant (Bergman and Goring-Morris 1987), regional variability is such that the use of the term 'Levantine Aurignacian' in connection with Upper Palaeolithic assemblages in the southern Levant is considered by some to be '… misleading and inappropriate' (Belfer-Cohen and Goring-Morris 1986:56). Notwithstanding, the extensive diversity within southern assemblages may, in part, be blamed on ambiguous definitions for the Ahmarian as well. Explanations of this inter-site lithic variability has led some to consider the possibilities of: 1) another blade-oriented technology independent of the Ahmarian (Coinman 1993a); 2) a separate 'cultural unit' within the Levantine Aurignacian distinct from Mediterranean woodland assemblages (Gilead 1991:128); 3) and/or sampling error, combined with functional variation and/or different stages in reduction, within the Early Ahmarian itself (Kerry 1997b, 2000).

The question of whether currently unclassified flake-oriented assemblages in the southern Levant, such as Tor Fawaz, are a facies of the Levantine Aurignacian, a completely distinct technological entity, or a functional/reductional variant within the Ahmarian is fundamental in understanding techno-typological variability within the entire region. In this light, the aim of this paper is to update Coinman and Henry's (1995) assemblage description of Tor Fawaz, adding to the current body of Upper Palaeolithic data from the southern Levant, and to discuss how this assemblage fits within the current interpretive framework.

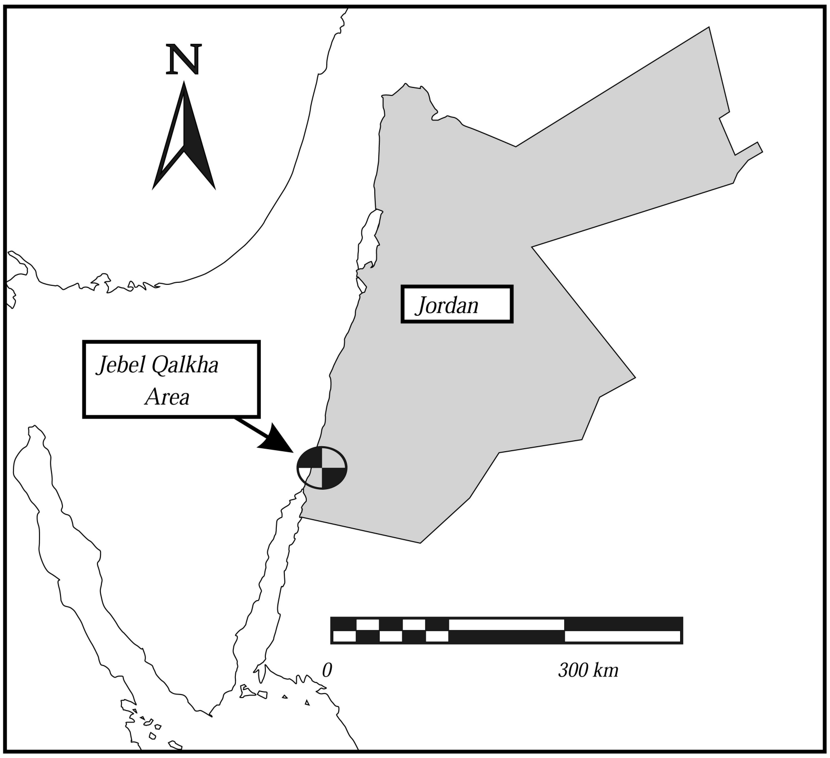


Fig. 14.1 Map of Jordan showing the location of the Jebel Qalkha study area.

Site Settings, Resources, and Palaeoenvironment

Tor Fawaz (J403) is one of several Palaeolithic sites located in the Jebel Qalkha area of southwest Jordan. The study area is located 10 km east of the Wadi Araba, some 60 km northeast of the Gulf of Aqaba (Fig. 14.1). Encompassing approximately 6 km^2, it is characterized by numerous rockshelters and overhangs found within the sandstone canyons that delineate the jebel (Fig. 14.2). Most of these canyons flow east emptying into Wadi Qalkha, which serves as a natural conduit between Wadi Araba and Wadi Hisma (Henry and Garrard 1988).

Located at an elevation of 975 m asl, Tor Fawaz is a shallow, south-facing rockshelter currently situated 15 m above the wadi bed forming the southern branch of Wadi Humeima. Its southern orientation provides adequate sunlight exposure and protection from prevailing winds that appear to have been out of the east during the Pleistocene rather than from the west and northwest as today (see Henry 1997). The shallow overhang of this rockshelter extends just over 25 m along a steep cliff. Within the shelter, two distinct areas of large sandstone blocks and thick dung layers point to recent utilization by the local Bedouin herders. Flint artefacts are scattered well beyond the drip-line of the shelter nearly to the edge of the wadi, encompassing over 1000 m^2 in area. While the surface area of Tor Fawaz seems to represent a very large Upper Palaeolithic site, the area of the site is likely exaggerated due to the dispersal of artefacts on the steep slope (Coinman and Henry 1995).

Plentiful chert resources are present directly adjacent to Tor Fawaz. A limestone hill containing chert outcrops provides high quality raw material, but these nodules are hard to extract and utilization is usually dependent on natural erosion. In addition to this high quality nodular chert, a lower quality vein chert is also located within the same limestone hill, but this material is very hard to remove and has a tendency to fracture unpredictably upon striking. Furthermore, small rolled cobbles, often of high quality, can be found in and along the beds of both adjacent wadis. A fourth known raw material source, 20–22 km away on the Ma'an plateau, contains abundant large nodules of high quality flint.

The steep-walled canyons and wadis in the Jebel Qalkha area reflect the extensive runoff that still occurs occasionally. Today, surface water is easily obtained during the winter season, when it collects in bedrock pools (Coinman and Henry 1995). An extinct spring was discovered directly across the wadi from Tor Fawaz. How long ago it flowed has not been determined, but similar evidence of Middle and Upper Palaeolithic sites in direct association with extinct springs is found in the Avdat/Aqev area of the central Negev (Goldberg 1981) and in the Wadi Hasa region of west-central Jordan (Clark *et al.* 1988).

Much as today's climate, the palaeoenvironment was

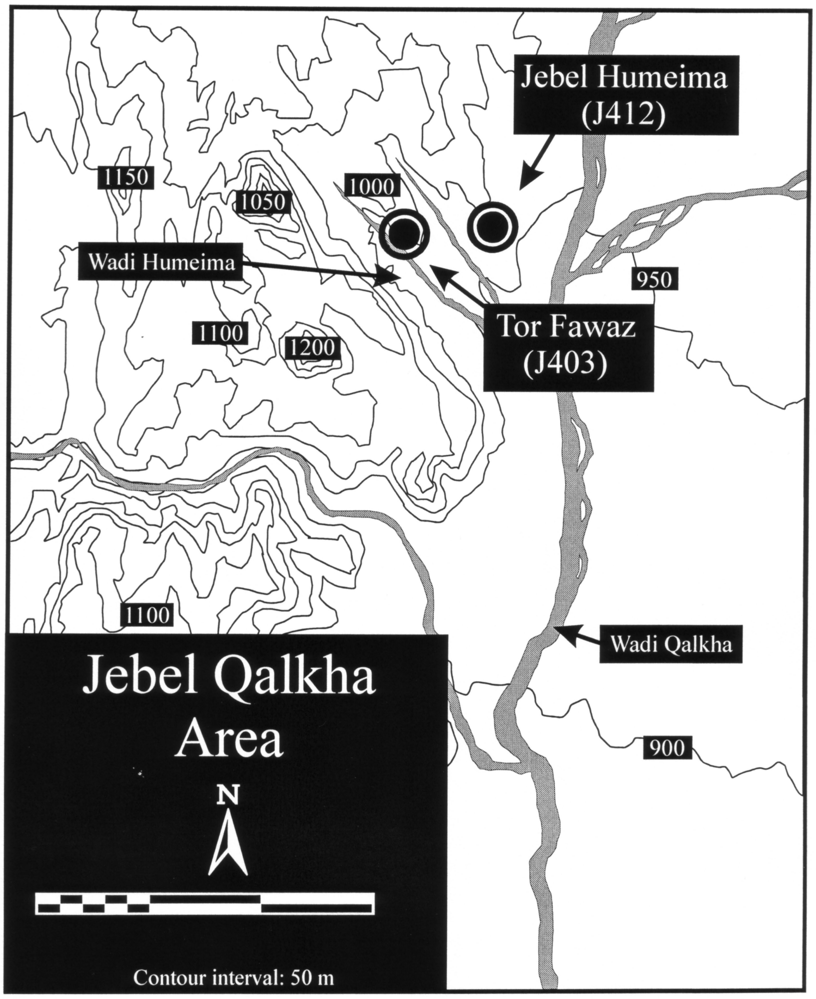


Fig. 14.2 Map of Jebel Qalkha area showing the location of Tor Fawaz (J403) and nearby site of Jebel Humeima (J412).

determined by topography as it was by climatic patterns in general. The varied relief dictates the amount of precipitation, temperature patterns, and the flora throughout the region. Three distinct elevationally governed environmental zones include a small tract of Mediterranean woodlands between 1700–1400 m asl, Asiatic steppe from 1400–1000 m asl, and African desert below 1000 m asl (el-Eisawi 1985). As precipitation levels fluctuated during the late Pleistocene, the boundaries between these environmental zones shifted higher during dry intervals and dropped in elevation during more humid periods. Tor Fawaz, at about 975 m asl, resides at the current division separating the Asiatic steppe and the African desert. While an ecotone location is advantageous to a foraging subsistence, allowing for the exploitation of two ecological settings, the location of this ecotone was undoubtedly different in the past. Climatic fluctuations would have made J403 more desirable during some periods of prehistory than others.

The Upper Palaeolithic deposits of Tor Fawaz most likely correlate with the last half of Oxygen-Isotope Stage (OIS) 3, lasting from approximately 60–28 Ky. While most scholars agree that OIS 3 in the Levant was characterized by fluctuations of wet and dry periods, there is conflicting data on when these fluctuations occurred. Pollen spectra and $\delta^{18}O$ curves from the southeast Mediterranean Sea show continuous climatic fluctuation, reflecting a high degree of instability throughout the later part of OIS 3 (Cheddadi and Rossignol-Strick 1995). Records of $\delta^{18}O$ and $\delta^{13}C$ in speleothems from Soreq Cave, Israel, offer perhaps the most reliable regional record of palaeoclimate due to the high chronological resolution provided by 78 TIMS ^{230}Th-U dates (Bar-Matthews *et al.* 2000a; Bar-Matthews and Ayalon this volume). This study identified fluctuating environmental conditions throughout OIS 3 with very cold and dry conditions occurring at 46 and 35 Ky preceeded by a period of increased hydrological activity and rainfall, peaking around 54 Ky.

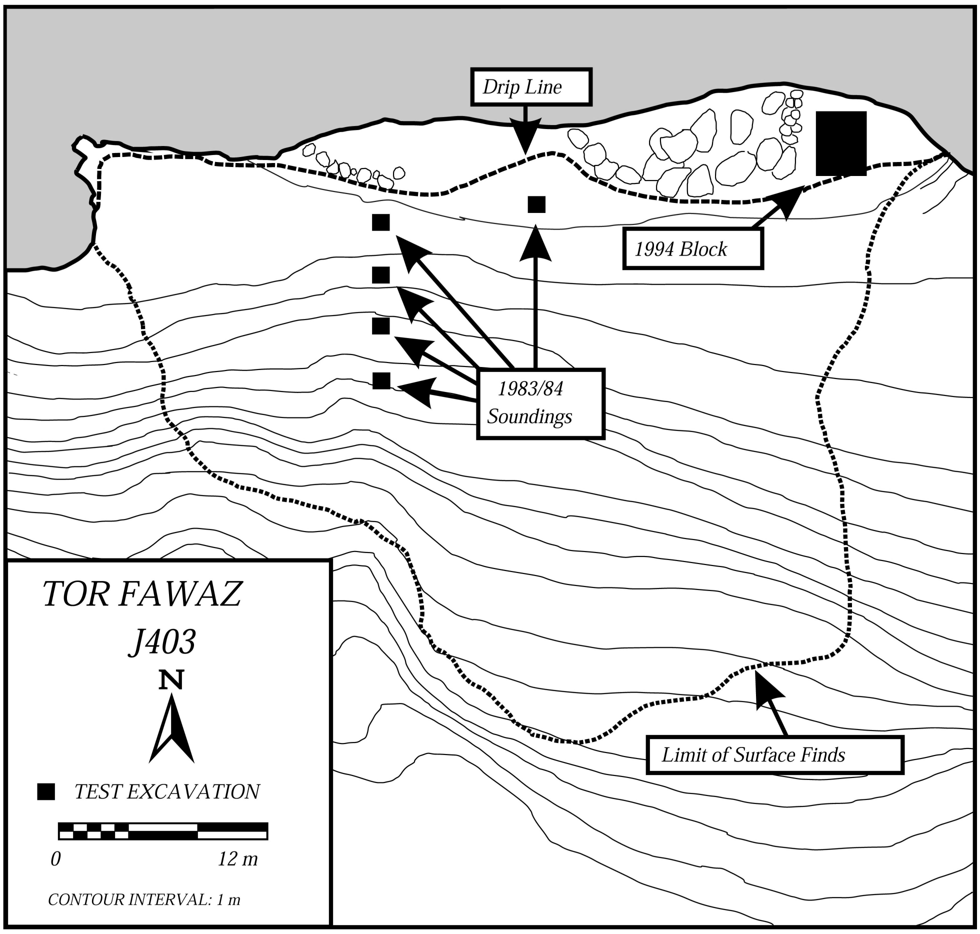


Fig. 14.3 Area excavated at the Tor Fawaz (J403) rockshelter during 1983 and 1984 field seasons and the larger excavation block (3x4 m) excavated in 1994.

Site Plan, Methodology, and Stratigraphy

The results of initial (1983/84) soundings at J403 were briefly discussed by Henry (1988) and Coinman (1993a), followed by a more extensive report by Coinman and Henry (1995). These early probes (five 1m² units) suggested that a shallow and most likely displaced cultural deposit was present on the slope beneath the shelter and that a thicker, largely intact deposit was to be found behind the drip-line (Fig. 14.3). The subsequent excavation (3 x 4 m block) undertaken behind the drip-line in 1994 confirmed a more extensive deposit with a thickness of one metre. The excavation methodology largely remained unchanged throughout the investigation. Recovery was controlled by either 1 or 0.5 m² excavation units and 10 cm maximum arbitrary levels. All matrix was dry-sieved through 3 mm mesh

The excavation block, extending from near the shelter's back wall to just inside the drip-line, provides the best view of the stratigraphy of the deposit. The exposure reveals five stratigraphic layers (A, B_1, B_2, C, and D) resting against bedrock (Fig. 14.4). Layers A, B_1 and B_2 show obvious evidence of disturbance in the form of ash and dung. Layer A consists of a loose, powdery dark grey to black silt rich in twigs, dung, ash and charcoal. Layer B grades from a grey (B_1) to a tan (B_2) silt and exhibits progressive calcification and compaction with depth. An ash and dung-filled pit, extending from Layer A, also truncates layers B_1 and B_2. Layer C consists of a very compact yellow silt overlying bedrock and pockets of red sand that form Layer D. Given the presence of Upper Palaeolithic artefacts throughout Layers A-C, it seems likely that Layer A and B simply represent different degrees to which Layer C has been subjected to disturbance and reworking.

Layers C (yellow silt) and D (red sand) have been stratigraphically correlated to widespread off-site exposures in the Jebel Qalkha area, Q2 and Q3 respectively, as well as to other Upper and Middle Palaeolithic deposits (Henry 1997). Layer C, corresponding to the Q2 Yellow Silt, represents loess sedimentation stratified between accumulations of red sands (Q1 and Q3) thought to denote drier intervals. The Q1 Red Sand contains Epipalaeolithic occupations dated to post-18,000 bp, whereas the Q3 Red Sand is linked to Middle Palaeolithic occupations dated

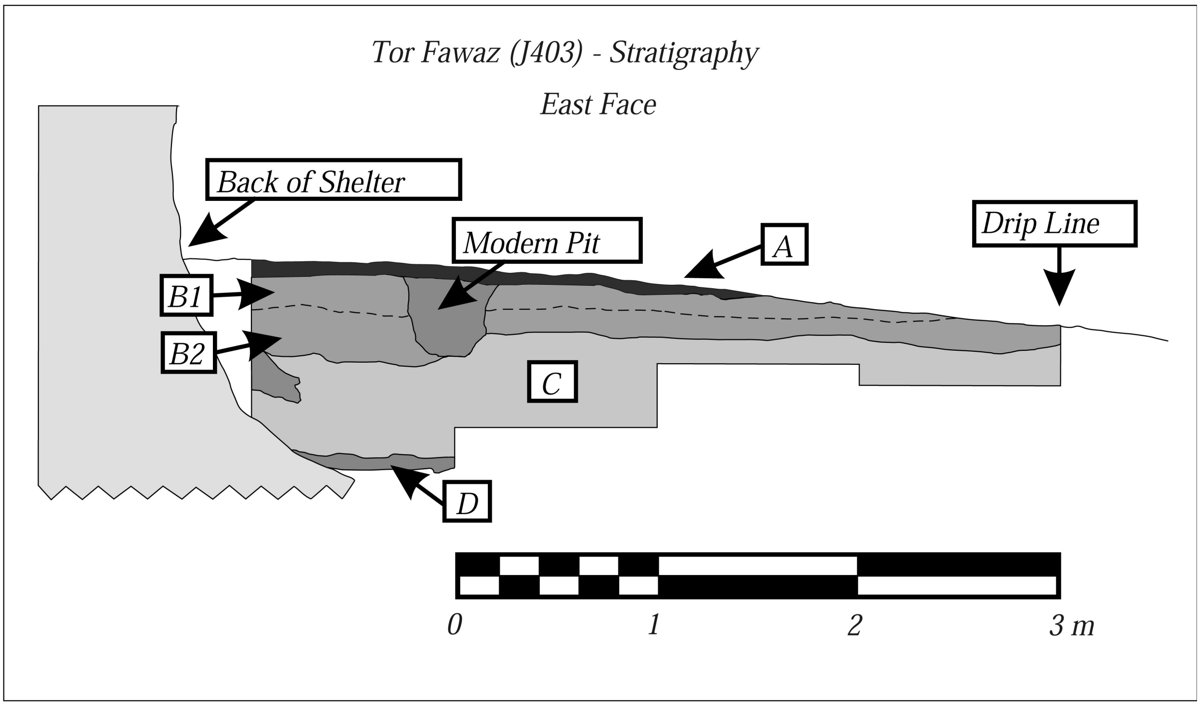


Fig. 14.4 Stratigraphy of Tor Fawaz (J403).

to 70–50 Ky. The thick accumulation of loess forming the Q2 Yellow Silt is thought to have signalled moister conditions and overall landscape stability in the Jebel Qalkha. Sufficient moisture must have been available to support a dense enough vegetation cover to have entrapped loess derived from fluvial outwash and from mud flats located in the central part of the basin. Pollen spectra recovered from the Q2 Silt indicate grassland interspersed with oak and alder (Emery-Barbier 1995) and the presence of a palaeosol early in the sedimentation of silt indicates stability of the local landscape.

The Lithic Assemblage

The bulk of the material recovered from Tor Fawaz is represented by chipped stone artefacts and relatively little organic material was preserved. Both the 1983/84 and 1994 lithic assemblages exhibit evidence of post-depositional damage, but abrasion and edge damage seem to occur to a lesser extent in the 1994 excavation block which is located further upslope and behind the dripline than the five test units from 1983/84. Despite evidence for post-depositional artefact damage and erosion, the full range of production appears to be relatively intact. Percentages of tools, debitage, and debris are similar to the other Upper Palaeolithic assemblages in the Jebel Qalkha area.

The small number of artefacts consistent with the Levantine Mousterian do not appear to fall within any recognizable vertical intervals, but rather are dispersed within the aeolian (Q2) layer commonly associated with Upper Palaeolithic occupations throughout the Jebel Qalkha study area. Whether the dispersal of artefacts associated with Middle Palaeolithic production represents post-depositional mixing and/or cultural recycling by later Upper Palaeolithic occupants of Tor Fawaz is not known. While there may be a distinction between less compact and more compressed (or calcified) Q2 sediments at approximately 50 cm below datum, the 1994 assemblage is divided arbitrarily into 10 cm levels for intra-site analysis (Table 14.1). Both the 1983/84 and 1994 assemblages are combined into one sample for inter-site comparison (Table 14.2).

The Levantine Aurignacian/Ahmarian Techno-typological Framework

Traditionally, distinctions between the Levantine Aurignacian and Ahmarian technologies revolve around the percentage production of blades and bladelets versus flakes. The Levantine Aurignacian is usually defined as a flake-based technology, although both retouched blade and flake blanks may occur in Levantine Aurignacian tool assemblages (Bar-Yosef and Belfer-Cohen 1996). Blanks appear to have been produced using at least two different reduction strategies - one for large blades and the other for the production of very small, twisted bladelets from larger blanks (Ferring 1988). However, many Levantine Aurignacian assemblages exhibit a highly varied reduction strategy and cores are often quite amorphous, while platforms may be represented by both single-faceted and multi-faceted varieties. Levantine Aurignacian tool kits are also considered to include high proportions of burins and endscrapers (Gilead 1981a, 1991). Diagnostic stone

Table 14.1 Artefact inventory of the 1994 Tor Fawaz (J403) assemblage.

	0–10cm		10–20cm		20–30cm		30–40cm		40–50cm		50–60cm		60–70cm		70–100cm*		Totals	
Tools	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Sidescrapers	–	–	1	3.4	–	–	–	–	–	–	–	–	–	–	–	–	1	0.9
Endscrapers	4	11.4	2	6.9	–	–	1	5.9	–	–	2	28.6	–	–	1	25.0	10	8.8
Burins	1	2.9	3	10.3	2	16.7	2	11.8	–	–	–	–	–	–	–	–	8	7.1
Truncations	1	2.9	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	0.9
Notches	2	5.7	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	1.8
Denticulates	–	–	1	3.4	–	–	–	–	–	–	1	14.3	–	–	–	–	2	1.8
Retouced Pcs.	15	42.9	14	48.3	8	66.7	11	64.7	4	100.0	2	28.6	3	60.0	2	50.0	59	52.2
Retouched Bldts.	2	5.7	2	6.9	–	–	–	–	–	–	–	–	–	–	–	–	4	3.5
Trunc.-Faceted	7	20.0	3	10.3	1	8.3	3	17.6	–	–	1	14.3	1	20.0	1	25.0	17	15.0
Levallois Pt.	–	–	3	10.3	–	–	–	–	–	–	1	14.3	1	20.0	–	–	5	4.4
El-Wad Pt.	3	8.6	–	–	1	8.3	–	–	–	–	–	–	–	–	–	–	4	3.5
Sub-Total:	35	100.1	29	99.8	12	100.0	17	100.0	4	100.0	7	100.1	5	100.0	4	100.0	113	99.9

	0–10cm		10–20cm		20–30cm		30–40cm		40–50cm		50–60cm		60–70cm		70–100cm*		Totals	
Debitage	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Cores	7	5.3	4	5.9	2	7.4	3	4.6	1	3.8	2	9.5	–	–	1	8.3	20	5.4
Bladelets	17	12.9	4	5.9	3	11.1	4	6.2	1	3.8	–	–	–	–	1	8.3	30	8.1
Blades	19	14.4	11	16.2	3	11.1	8	12.3	3	11.5	–	–	2	11.1	1	8.3	47	12.7
Flakes	56	42.4	35	51.5	16	59.3	40	61.5	16	61.5	12	57.1	10	55.6	7	58.3	192	52.0
Levallois Flakes	–	–	3	4.4	1	3.7	2	3.1	1	3.8	–	–	–	–	–	–	7	1.9
Core Trim. Elem.	8	6.1	1	1.5	–	–	1	1.5	–	–	2	9.5	–	–	–	–	12	3.3
Primary Elem.	23	17.4	10	14.7	2	7.4	7	10.8	4	15.4	5	23.8	6	33.3	2	16.7	59	16.0
Burin Spalls	2	1.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	0.5
Sub-Total:	132	100.0	68	100.1	27	100.0	65	100.0	26	99.8	21	99.9	18	100.0	12	99.9	369	99.9

	0–10cm		10–20cm		20–30cm		30–40cm		40–50cm		50–60cm		60–70cm		70–100cm*		Totals	
Debris	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Chips	323	95.3	54	84.4	60	88.2	142	95.3	23	88.5	65	85.5	71	95.9	34	94.4	772	92.8
Chunks	16	4.7	10	15.6	8	11.8	7	4.7	3	11.5	11	14.5	3	4.1	2	5.6	60	7.2
Sub-Total:	339	100.0	64	100.0	68	100.0	149	100.0	26	100.0	76	100.0	74	100.0	36	100.0	832	100.0

	0–10cm		10–20cm		20–30cm		30–40cm		40–50cm		50–60cm		60–70cm		70–100cm*		Totals	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Tools	35	6.9	29	18.0	12	11.2	17	7.4	4	7.1	7	6.7	5	5.2	4	7.7	113	8.6
Debitage	132	26.1	68	42.2	27	25.2	65	28.1	26	46.4	21	20.2	18	18.6	12	23.1	369	28.1
Debris	339	67.0	64	39.8	68	63.6	149	64.5	26	46.4	76	73.1	74	76.3	36	69.2	832	63.3
Totals:	506	100.0	161	100.0	107	100.0	231	100.0	56	99.9	104	100.0	97	100.1	52	100.0	1314	100.0

*Levels 70–80cm, 80–90cm, and 90–100cm were collapsed due to small sample size.

tools include: small, twisted, and retouched bladelets, or *lamelles Dufour*, carinated burins and endscrapers, and large blades with scalar, or Aurignacian, retouch.

The Ahmarian has been divided into early and late components (Ferring 1988). Despite statistical distinctions between the Early and Late Ahmarian lithic assemblages (see Coinman 1990), the Late Ahmarian is considered the terminal phase of Ahmarian technology with a focus on blade and bladelet production (Coinman 1998a). The Late Ahmarian is ordinarily placed within the Upper Palaeolithic. However, the increased focus on microlithic production, coupled with late dates – many of which are within the range usually considered Epipalaeolithic – may alternately position the Late Ahmarian within the Epipalaeolithic rather than the Upper Palaeolithic (Goring-Morris 1995b; Goring-Morris and Belfer-Cohen 1997).

Early Ahmarian lithic technology centred on the production of slender blades and bladelets from single platform and, to a lesser extent, opposed platform cores, through soft hammer manufacture. Core rejuvenation was

Table 14.2 Combined artefact inventory totals of the 1984 and 1994 Tor Fawaz (J403) assemblages.

	1983/84		1994		Totals	
Tools	N	%	N	%	N	%
Sidescrapers	–	–	1	0.9	1	0.2
Endscrapers	20	6.0	10	8.8	30	6.7
Burins	18	5.4	8	7.1	26	5.8
Perforators	3	0.9	–	–	3	0.7
Truncations	28	8.4	1	0.9	29	6.5
Notches	53	15.9	2	1.8	55	12.3
Denticulates	6	1.8	2	1.8	8	1.8
Retouched Pieces	168	50.5	59	52.2	227	50.9
Retouched Bladelets	24	7.2	4	3.5	28	6.3
Truncated-Faceted*	–	–	17	15.0	17	3.8
Multiple Use Tools	7	2.1	–	–	7	1.6
Massive Pieces	3	0.9	–	–	3	0.7
Levallois Points	3	0.9	5	4.4	8	1.8
El-Wad Points	–	–	4	3.5	4	0.9
Sub-Total:	333	100.0	113	99.9	446	100.0
	1983/84		1994		Totals	
Debitage	N	%	N	%	N	%
Cores	23	1.4	20	5.4	43	2.1
Bladelets**	–	–	30	8.1	30	1.5
Blades	680	41.0	47	12.7	727	35.8
Flakes	748	45.1	192	52.0	940	46.4
Levallois Flakes	–	–	7	1.9	7	0.3
Core Trimming Elements	35	2.1	12	3.3	47	2.3
Primary Elements	163	9.8	59	16.0	222	10.9
Burin Spalls	10	0.6	2	0.5	12	0.6
Sub-Total:	1659	100.0	369	99.9	2028	99.9
	1983/84		1994		Totals	
Debris	N	%	N	%	N	%
Chips	1253	62.9	772	92.8	2025	71.7
Chunks	738	37.1	60	7.2	798	28.3
Sub-Total:	1991	100.0	832	100.0	2823	100.0
	1983/84		1994		Totals	
	N	%	N	%	N	%
Tools	333	8.4	113	8.6	446	8.4
Debitage	1659	41.6	369	28.1	2028	38.3
Debris	1991	50.0	832	63.3	2823	53.3
Totals:	3983	100.0	1314	100.0	5297	100.0

*Truncated-faceted pieces were not recorded in the analysis of the 1983/84 material (Coinman and Henry 1995).
**Bladelets were included with blades in the analysis of the 1983/84 material (Coinman and Henry 1995).

frequently undertaken with the core tablet technique, producing a new platform. As a result, blanks detached from these cores usually exhibit plain platforms. Late Ahmarian reduction processes, however, became more varied, using several different kinds of blanks and employing opposed platform cores with higher frequency (Ferring 1988).

Technology

Because of the limited excavation area and the possibility of post-depositional mixing, technological analysis is limited primarily to the examination of debitage production. Only 43 cores, representing 2.1% of the debitage at Tor Fawaz, were recovered (Table 14.2). Cores found in 1994 seem to closely resemble the core assemblage recovered during the 1983 and 1984 field seasons characterized primarily by single and opposed platform prismatic cores, and, to a lesser extent, change-of-orientation cores (Figs. 14.5–6). Core rejuvenation *via* the core tablet technique appears to be heavily utilized in the 1983/84 collection (Coinman and Henry 1995), while very few core tablets were found within the 1994 assemblage. However, the overall percentage of core trimming elements recovered in 1994 (3.3%) is slightly higher than the amount recovered in 1983/84 (2.1%), suggesting a similar amount of core rejuvenation is represented in both samples.

Blanks from Tor Fawaz were dominated by flakes followed closely by blades. There appears to be no clear focus on the goals of production for the entire sample since both flakes (46.4%) and blades (35.8%) occur in similar frequencies. However, when looking at the two samples separately the 1994 sample shows a much higher occurrence of flakes (52.0%) over blades (12.7%), while the larger 1983/84 sample has relatively analogous flake (45.1%) and blade (41.0%) frequencies. Bladelet production, traditionally associated with the Ahmarian, is present but apparently was not a primary reduction focus. Bladelets account for only 8.1% of the debitage in the 1994 sample**,** and while bladelets were grouped with blades in the 1983/84 sample, they appear not to have been a major component of that category. Typically, bladelets are described as less than 50 mm in length and 12 mm in width, while blades are larger in both aspects (Tixier 1963). Dimensional data from Coinman and Henry's initial analysis of Tor Fawaz (1995:147) show that while the mean length (42.6 mm) for blades would fit bladelet dimensions, the mean width (16.6 mm) supersedes traditional bladelet definitions. Furthermore, many of the blade blanks from the 1983/84 sample appear to represent decortication and initial core shaping, or 1st and 2nd order removals as identified by Coinman and Henry (1995:146). The 1994 sample does not contradict this observation and many blades seem to have been produced early in the reduction process. Primary elements, more abundant in the 1994 sample, appear in somewhat higher frequency in the deepest levels, accounting for the higher overall occurrence in the 1994 sample. Whether this distinction in primary elements indicates spatial variability in initial core shaping, however, is not clear. Burin spalls were barely represented in both samples (0.6%), mirroring the small amount of burins found within the tool assemblage (5.8%).

Typology

The retouched tools for the combined sample represent 8.4% of the total lithic assemblage from Tor Fawaz. This is a much higher tool percentage than for any other Upper Palaeolithic assemblage from the Jebel Qalkha area. The categories of retouched tools used in Tables 14.1 and 14.2 are a synthesis of both Middle and Upper Palaeolithic artefact inventory tables originally used to describe assemblages in the Jebel Qalkha area (Henry 1995; Coinman and Henry 1995). Considerable variability is found in most tool classes. Retouched pieces were the most prevalent tool class in both the 1983/84 (50.5%) and 1994 samples (52.2%). In the combined sample notches were the second most frequent tool class (12.3%), however the majority of these were found in the earlier field season outside the dripline of the rockshelter and only 1.8% of the 1994 tool assemblage is represented by notches. Whether the spatial distribution of notched tools reflects past behavioural or post-depositional activity is not clear. Tool classes considered diagnostic of either Early Ahmarian or Levantine Aurignacian traditions, such as el-Wad points or carinated pieces are nearly nonexistent in the 1983/84 sample and only one carinated endscraper was found. While no carinated elements were found during the 1994 season, four el-Wad points were recovered, accounting for 0.9% of the combined tool assemblage.

Endscrapers and burins, originally considered to occur in high frequencies in Levantine Aurignacian assemblages relative to Ahmarian assemblages (Gilead 1981a), occur in relatively low frequencies, only 6.7% and 5.8% respectively. Endscrapers were made on primary elements, cores, and occasionally core trimming elements, with both flakes and blades being the most commonly utilized blanks (Figs. 14.7–8). Simple varieties with lightly retouched working bits are the most common endscraper type. Several exhibit lateral retouch, although little evidence of resharpening was found. Burins were made using a variety of debitage types, but flake blanks predominate. Angle burins on breaks and a variety of dihedral burins are the most common varieties, with very few multiple types present.

Eight Levallois points, seven Levallois flakes, along with a small percentage of blanks displaying faceted platforms were recovered throughout the Upper Palaeolithic strata. However, these elements do not seem to correlate with any stratigraphic trends (Table 14.1). One of the Levallois points had been reworked into an endscraper, exhibiting two different degrees of patination. To what extent this dispersal is due to cultural recycling of earlier material or represents post-depositional mixing is not known; however, some degree of cultural recycling appears to have taken place due to the occasional presence of double patination.

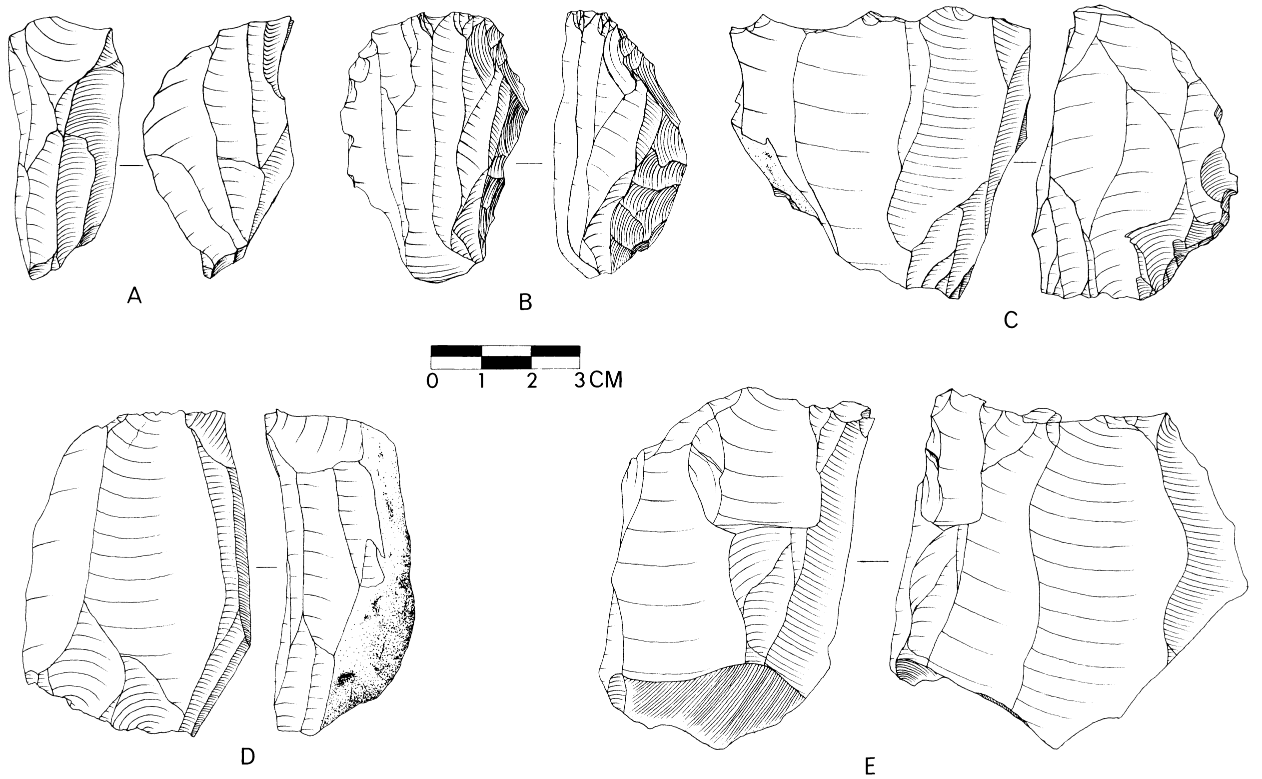


Fig. 14.5 Cores from the 1994 excavation at Tor Fawaz (J403): (A, C, D) opposed platform blade-bladelet cores, (B) change-of-orientation core, and (E) single platform blade core.

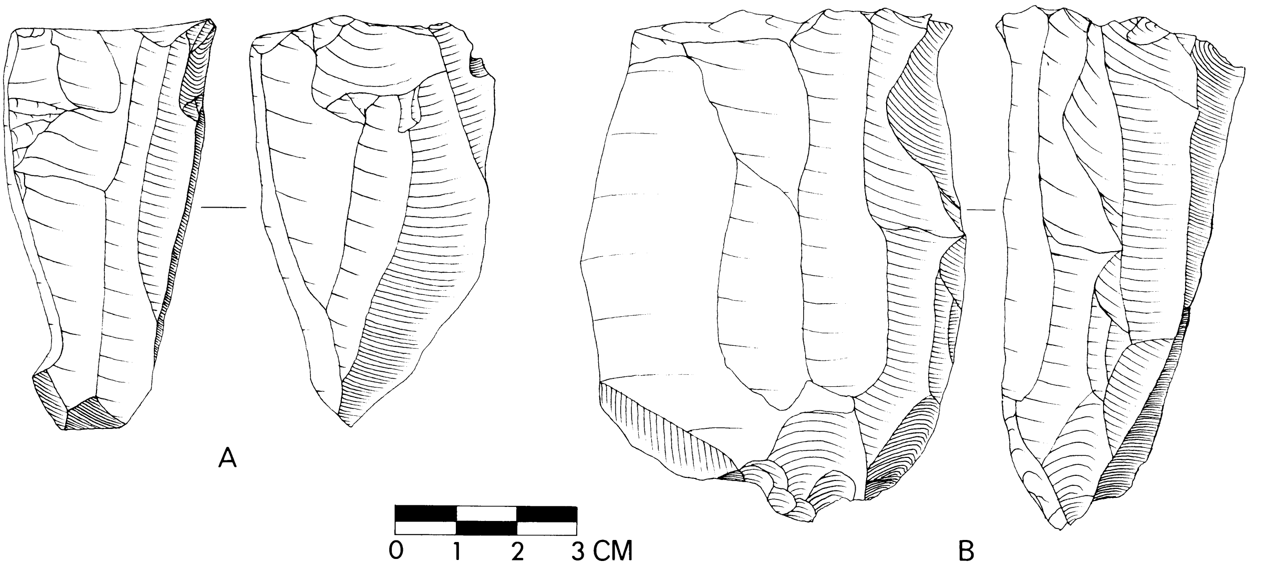


Fig. 14.6 Cores from the 1994 excavation of Tor Fawaz (J403): (A, B) single platform blade cores.

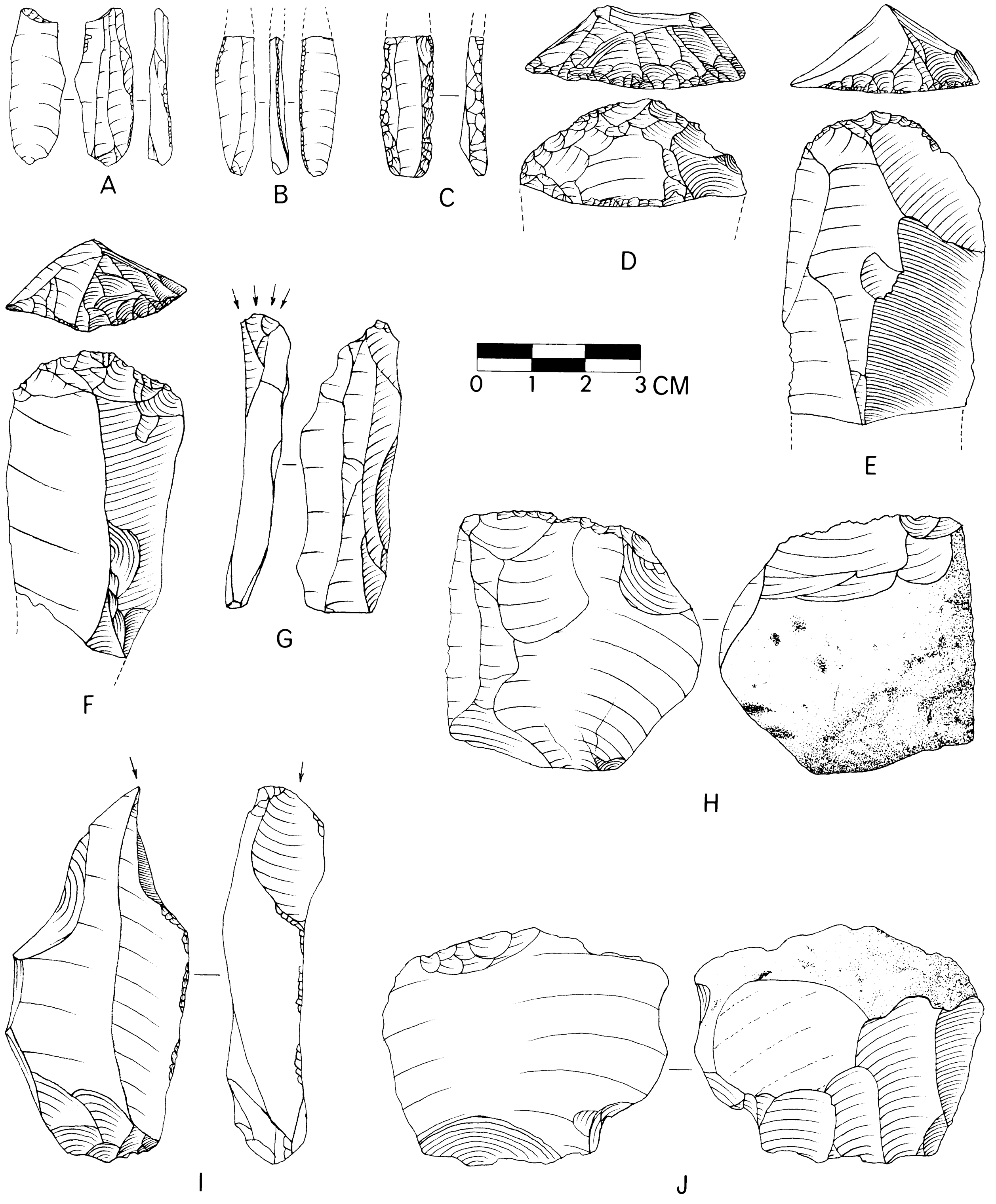


Fig. 14.7 Tools from the 1994 excavation of Tor Fawaz (J403): (A-C) retouched bladelets, (D-F) simple endscrapers, (G, I) dihedral burins, and (H, J) truncated-faceted pieces.

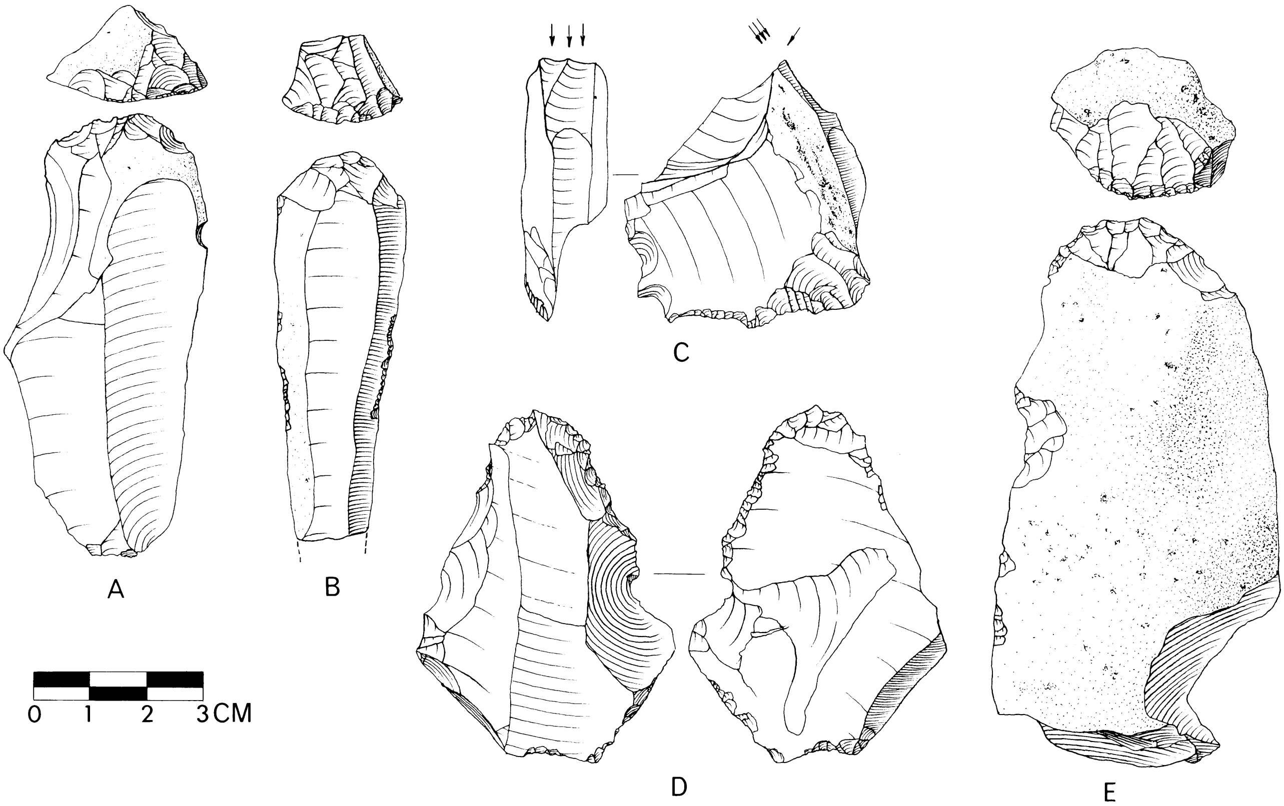


Fig. 14.8 Tools from the 1994 excavation of Tor Fawaz (J403): (A, B, E) simple endscrapers, (C) dihedral burin on retouched flake, and (D) Clactonian notch on retouched flake.

While not recorded in the 1983/84 analysis, 15% of the 1994 tool assemblage is represented by truncated-faceted pieces, or blanks exhibiting Nahr Ibrahim retouch. This method of blank manipulation initially identified by Schroeder (1969) is usually associated with Levantine Mousterian technology. However, truncated-faceted pieces have also been recognized in the early Upper Palaeolithic deposits from Kebara Cave (Belfer-Cohen, personal communication) and at the nearby site of Jebel Humeima (J412), accounting for nearly 5% of the tools in Horizons II and III which are associated with the Early Ahmarian (Kerry 1997b:51, 2000). Truncated-faceted pieces are recognized by large, ordinarily ventral removals on flake blanks in order to create a platform and sometimes for thinning flake blanks for subsequent tool utilization (Solecki and Solecki 1970; Goren-Inbar 1988; Henry *et al.* 1996). While some truncated-faceted pieces from Tor Fawaz may represent tool modification, the high occurrence of large, ventral flake removals suggest truncated-faceted pieces from Tor Fawaz were typically used as cores (Fig. 14.7).

Discussion

Unlike the nearby site of Jebel Humeima (J412) where increased sample size led to the reinterpretation of the lithic assemblage as Early Ahmarian rather than Levantine Aurignacian, the enlarged lithic assemblage from Tor Fawaz fails to adequately fit neatly within either tradition. While the dominance of flake blanks is compatible with many assemblages considered Levantine Aurignacian, the large amount of core tablets recovered during the 1983/84 field seasons is consistent with Early Ahmarian reduction strategies. Indeed, the description of Tor Fawaz as ‘non-Ahmarian’ may still be its best characterization, based on current techno-typological parameters (Coinman and Henry 1995:194). The lack of diagnostic elements, such as high proportions of carinated elements, Aurignacian retouch, or *lamelles Dufour*, makes a correlation between J403 and the Levantine Aurignacian problematic. However, an Ahmarian designation is not strongly buttressed by diagnostic elements either. While four el-Wad points were recovered (0.9% of the tool assemblage), el-Wad points typically are found in higher percentages (6–13 %) within assemblages considered Early Ahmarian.

Although high percentages of certain tool types (*i.e.*, el-Wad points, *lamelles Dufour*, or carinated elements) are typically used to identify assemblages as either Early Ahmarian or Levantine Aurignacian, several sites in the southern Levant, like Tor Fawaz, lack significant proportions of these diagnostic elements (*i.e.* Arkov, D27a

[Marks and Ferring 1976]; QB602 [Gilead and Bar-Yosef 1993]; Siq Umm al-Alda [Schyle and Gebel 1997]). Where diagnostic elements are lacking, percentages of endscrapers and burins combined with flake and blade/bladelet frequencies are commonly used in distinguishing Early Ahmarian from Levantine Aurignacian assemblages. However, in comparing lithic assemblages from over 30 sites from the Negev, Sinai, west-central and southwest Jordan, percentages of endscrapers and burins display extensive variability, with a great deal of percentage overlap between both assemblage groups (Kerry 1997a:101, 2000). Similarly, flake and blade/bladelet frequencies associated with these same assemblages also show a high degree of variability, although generally the results fit within the current model. However, assemblages are currently classified as either Ahmarian or Levantine Aurignacian based in part on these debitage frequencies, so they should be expected to follow current interpretive models.

Rather than focusing on typology to distinguish Upper Palaeolithic traditions in the southern Levant, Gilead (1989) stressed the use of technological indicators. However, proportional comparisons, metrical statistical correlations, and multivariate analysis of tools and debitage display a lack of distinction between several southern Levantine assemblages considered Ahmarian and Levantine Aurignacian (Coinman 1990). Indeed, many assemblages that appear to differ notably in terms of tool typology are often quite similar technologically (Ferring 1988). Moreover, core characteristics of these two assemblage groups often demonstrate more affinity than dissimilarity (Coinman 1990:315).

The lack of a clear underlying typological or technological distinction between these two assemblage groups, combined with an almost virtual absence of diagnostic Levantine Aurignacian elements within nearly all south Levantine Early Upper Palaeolithic assemblages, may suggest the lack of a true dichotomy altogether. The lack of evidence demonstrating two culturally distinct lithic traditions indicates either our current taxonomic framework is inordinately vague and/or other factors for inter-site lithic variability need to be explored. However, little has been done to investigate causes of variability between assemblages that seem more blade/bladelet-oriented and those that appear to focus on flake production. What considerations may be evaluated in interpreting inter-site variability apart from techno-typological distinctions? Raw material access and utilization, sampling error representing different ‘stages’ of a common reduction stream and/or different activities, varied aspects of resource acquisition and mobility, as well as problems of stratigraphy and chronology may all figure into the equation for lithic assemblage variability in the Upper Palaeolithic of the southern Levant.

While a certain amount of variability in the process of manufacture and tool utilization is to be expected in any period of prehistory, there has been little research in the way varied reduction strategies are related to raw material characteristics and access in the Upper Palaeolithic of the southern Levant. While many sources of high quality raw material are available throughout the Negev, Sinai, and southwest Jordan, to what degree blank types are related to the size and shape of raw material and the distance to raw material needs to be actively addressed. Examples of techno-typological variation as a factor of raw material size and shape within the Epipalaeolithic (Bar-Yosef 1991a) and in relation to the distance of raw material during the Middle Palaeolithic (Henry 1989b; Kuhn 1991) demonstrate how aspects of raw material other than quality affect blank production.

Sampling error may also be partially responsible for much of the variability found between Upper Palaeolithic lithic assemblages in the southern Levant. As discussed earlier, clusters of distinct tool and debitage types recovered from the initial soundings at Jebel Humeima (J412) produced an assemblage that appeared Levantine Aurignacian, while later soundings and the combined larger sample provided an unmistakable Early Ahmarian assemblage. Similarly, clusters of core tablets and notched tools at Tor Fawaz occur in considerably higher frequencies in the 1983/84 sample than were recovered in 1994. Other examples of extreme intra-site techno-typological variability have also been noted within the Early Ahmarian strata of Boker where distinct clusters of tools and debitage were recorded, with as much as 90% of a particular tool class found within a few square metres (Marks and Ferring 1988:60). As Marks and Ferring point out, small excavations could have easily misrepresented the actual identity of the Upper Palaeolithic components at Boker, or any given stratum at sites with similar artefact distributions. Given the small excavation size of many Upper Palaeolithic sites (indeed, many lithic descriptions are based solely on soundings), sample size emerges as an important consideration in recognizing variability within the southern Levant.

Sampling error may also be responsible for recovering only fragments of a common reduction process or artefacts related to specific reduction activity. Again at Jebel Humeima, spatial differentiation was responsible not only for techno-typological variability, but apparently represent distinct activity loci. These loci seem to represent two activity areas within one (or more) occupation(s). The initial sounding, located outside the shelter’s drip-line, which reflects a flake-oriented assemblage concentrated toward primary core shaping, and the later excavation, which reveals a blade/bladelet-based assemblage, is more suggestive of blank and/or tool production deeper within the rockshelter (Kerry 1997b, 2000). Conversely, the higher proportion of flakes, primary elements, and cores from the 1994 excavation block located within the shelter at Tor Fawaz (Table 14.2), combined with the dissimilar core:tool, core:debitage, primary element:debitage, and core:primary element ratios from the ‘83/84 and ‘94 assemblages suggests initial

Table 14.3 Combined (1983/84 and 1994 assemblage) artefact ratios from the Upper Palaeolithic assemblage of Tor Fawaz (J403).

Ratios	1983/84	1994	Totals
Tools: Debitage	5.0	3.3	4.6
Cores: Tools	14.5	6.0	10.4
Cores: Debitage	72.1	18.6	47.2
Debitage: Chips	0.8	2.1	1.0
Primary Elm.: Debitage	10.2	6.3	9.1
Cores: Primary Elm.	7.1	3.0	5.2
CTE: Cores	0.7	1.7	0.9
Blades*: Flakes	1.1	4.1	1.3
Bladelets*: Flakes	–	6.4	31.3

*Bladelets were included with blades in the analysis of the 1984 sample (Coinman and Henry 1995).

core preparation and shaping may have occurred within the shelter (Table 14.3). Furthermore, clustering of core tablets and 'platform blades,' together representing over 85% of the core trimming elements from the '83/84 assemblage (Coinman and Henry 1995:145), suggests that later-stage core rejuvenation and maintenance at Tor Fawaz may have occurred in front of the shelter rather than inside the drip-line. While post-depositional processes must be considered – particularly in rockshelters, similar intra-site technological variability, possibly corresponding to specific activity loci, may also be seen at the Early Ahmarian open-air site of Abu Noshra II (Phillips 1988; and Becker this volume), located in southern Sinai, and at some of the open-air Lagaman sites in the northern Sinai (Bar-Yosef and Belfer 1977; Gilead 1983).

It has been suggested that toolkits were far less important in influencing human adaptation than were organizational aspects of resource acquisition (Butzer 1982:301). In this light, toolkits may be seen as reflecting resource acquisition strategies. Indeed, different and/or changing modes of resource acquisition may represent much of the variability seen in many Levantine Upper Palaeolithic lithic assemblages. During the first half of OIS 3 (*ca.* 60–45 ky), transitional Middle-Upper Palaeolithic adaptive strategies are described as being focused on intensive exploitation of the immediate resource environment (Marks 1983c:93, but see Lieberman 1993b). While there is considerable debate concerning environmental settings during this period of time, recent and well-dated isotopic evidence depicts relatively humid conditions between *ca.* 58–50 ky (Bar-Matthews *et al.* 2000a; Bar-Matthews and Ayalon this volume). Such conditions would have proved favourable to exploitation of the immediate environment and a heavy reliance on residential mobility. By *ca.* 45 ky, however, the environment became less stable and considerably drier (Cheddadi and Rossignol-Strick 1995; Henry 1997; Bar-Matthews *et al.* 2000a; Bar-Matthews and Ayalon this volume), culminating in contraction of the Mediterranean woodland zone. This more arid environment undoubtedly put a strain on many food and water resources, reducing their overall density. Group size, resource acquisition, and mobility are directly linked to abundance and distribution of food and water resources, and were certainly affected by this environmental change. Where resources are more unevenly distributed, hunter-gatherer groups are expected to make few residential moves annually, relying instead on logistic, or extended task-specific forays, by some group members (Binford 1980) and placing camps near reliable resources for longer periods of time (Butzer 1982:238–239).

While Levantine Upper Palaeolithic mobility may be characterized as 'enigmatic' (Lieberman 1993b:604), many scholars suggest that hunter-gatherer groups became highly mobile during this time frame (Marks and Friedel 1977; Marks 1981b; Coinman *et al.* 1986; Bar-Yosef and Belfer-Cohen 1989). Although common sense may suggest that highly mobile groups tend to utilize a small number of multi-functional tools, toolkits of highly mobile groups can be quite varied, including an exceedingly diverse range of different tool forms (Kuhn 1994). Based on Binford's model (1980:12), greater ranges of inter-site variability are directly proportional to the amount of dependence on a logistic strategy of mobility. While the lithic variability seen in the southern Levant may, or may not, represent the presence of logistic mobility, only recently have aspects of lithic inter-site variability as they relate to resource acquisition strategies been explored (*e.g.*, Kaufman 1988, 1998; Henry 1994, 1995a; Gladfelter 1997). Yet, most of these discussions still rely on the current, exceedingly vague taxonomic framework. More recently, however, Williams (2000) suggested that distinctions between flake and blade/bladelet assemblages may reflect aspects of site function and/or distance to water and raw material, thus implying that the Ahmarian-Aurignacian distinction in the southern Levant may be more economic and/or functional rather than cultural. Such a distinction may reflect variation in mobile strategies and/or behavioural adaptation in response to the climatic variability that seems to characterize OIS 3.

Discussions of lithic variability are not complete without considering aspects of stratigraphy and chronology. Unfortunately, the stratified multi-component caves and rockshelters present in the northern Levant are absent in southern Levant, with most sites represented by open-air ephemeral occupations. While there are some sites which have yielded multi-component assemblages, or sites, such as Tor Fawaz, which are characterized by relatively deep Upper Palaeolithic deposits, sites possessing different 'types' of Upper Palaeolithic assemblages and/or possessing clear stratigraphic breaks within the Upper Palaeolithic sequence are rare at best. Still, where flake- and blade/bladelet-focused assemblages occur in the same sequence, material considered to reflect

the Levantine Aurignacian overlies Early Ahmarian deposits. Buttressing this limited stratigraphic evidence, clusters of ^{14}C dates have been obtained from several sites. These dates establish the foundation for a chronological framework where blade/bladelet-focused assemblages associated with the Ahmarian pre-date those assemblages considered to be Levantine Aurignacian (see Appendix). Nearly every date associated with 'Levantine Aurignacian' sites in the southern Levant pre-date 20,000 bp, while most Early Ahmarian dates are older than 25,000 bp. This chronological distinction was first pointed out over a decade ago (Belfer-Cohen and Goring-Morris 1986; Goring-Morris 1987:420) and while characterizations of the Levantine Upper Palaeolithic typically describe Ahmarian and Levantine Aurignacian lithic traditions as being largely contemporaneous, neither stratigraphic evidence nor ^{14}C dates convincingly demonstrate this contemporaneity in the arid southern Levant.

Bordes and de Sonneville-Bordes (1971) suggest that recognition of distinct cultural groups or traditions be based on the presence of different technologies and tool types for use in similar activities. With a growing body of evidence that does little to separate many Upper Palaeolithic flake and blade/bladelet-based assemblages in the southern Levant, other causes for inter-site lithic variability desperately need to be explored. Future research needs to focus on reducing sampling error, and exploring how raw material shape and size are related to blank production. Research should also do more to understand and recognize Upper Palaeolithic reduction strategies through analytical techniques such as refitting analysis, and by exploring more behavioural causes for lithic variability such as intra-site activities and varying and/or changing mobility strategies. Proportions of non-diagnostic elements, such as endscrapers and burins and blade/bladelets versus flakes, presently used in characterizing assemblages within the Upper Palaeolithic of the southern Levant are highly variable and do little to support a dichotomy. While there do appear to be tendencies in blank production (*i.e.*, flakes versus blade/bladelets), different stages in the reduction process may account for this variation (see Becker this volume; Monigal this volume). Spatial clustering of specific tool and debitage types at sites such as Jebel Humeima and Boker demonstrates that, perhaps, something as uncomplicated as sample size and/or different stages in core reduction could be responsible for much of the current inter-site variability. Lastly, while greater stratigraphic resolution is unlikely in the southern Levant, the apparent chronological distinction between Ahmarian sites and sites referred to as Levantine Aurignacian underscore the need for more dates using various radiometric techniques – particularly since much of the this time period occurs at the fringes of ^{14}C dating (*ca*. 45–35,000 bp) where samples are particularly sensitive to contamination. Until these points are addressed, sites such as Tor Fawaz which do not fit easily within the current, and ambiguous, interpretive framework, will remain hard to place technotypologically.

Acknowledgements

We wish to thank Anna Belfer-Cohen and Nigel Goring-Morris for including us in this volume and the symposium that was its inspiration. We would also like to thank P. Jeffrey Brantingham, Todd A. Surovell, and especially Steven L. Kuhn for their insights, constructive criticisms, and helpful comments. However, we are responsible for the views expressed, as well as any mistakes. Support for this study was provided by grants from the National Science Foundation (DBS9223855) and the Office of Research, University of Tulsa.

15. Twisted Debitage and the Levantine Aurignacian Problem

Christopher A. Bergman

'*The twisted debitage, it continues through the whole sequence.*' J. Tixier, 1987

Introduction

Without doubt, the work conducted in the 1970s and 1980s in the southern portions of Israel and Sinai by A.E. Marks, O. Bar-Yosef, I. Gilead, A.N. Goring-Morris, and J.L. Phillips, was a breath of fresh air in the generally stagnant arena of Levantine Upper Palaeolithic and Epipalaeolithic studies. The research in the southern Levant was so extensive, and the results so significant, that it eclipsed the work being conducted in northern Israel, Syria, and Lebanon. The situation in the north was not helped by the protracted political unrest that brought a halt to important excavations such as those of Jacques Tixier (1970, 1974; Tixier and Inizan 1981) at Ksar Akil, Lebanon.

The scope and quality of the research in the southern Levant quickly dwarfed other parts of the region creating a somewhat unbalanced data-set. This resulted in a perspective that shifted away from the so-called type-sites of the north, like Ksar Akil and the Mount Carmel caves, and gravitated toward the southern, semi-arid regions. The view from the Sinai and Negev posited two contemporary, but unrelated, cultural entities called the Ahmarian and Aurignacian (Gilead 1981a, b; Marks 1981a). When the data from the southern Levant was compared with that from the north there were more differences than similarities. As J.L. Phillips exclaimed when shown the Early Ahmarian material from levels XX–XVI at Ksar Akil, 'my material [from Sinai] does not look anything like this' (Bergman 1988b:224).

The 1987 roundtable conference on 'The Levantine Upper Palaeolithic with Special Reference to Ksar Akil' held at the Institute of Archaeology, University of London (Bergman and Goring-Morris 1987), attempted to reach a unified opinion as to the nature of the Levantine Upper Palaeolithic. Belfer-Cohen and Goring-Morris (this volume) correctly believe that the 1987 conference was not as successful or influential in creating a common consensus and/or common definitions which enabled researchers to communicate their finds and express their ideas as the 1969 Wenner Gren Symposium. However, it could be argued that the 1987 conference did succeed in a couple of areas: 1) it underscored a growing awareness of the phenomenon of localized assemblage variability; and 2) it called into question the widespread application of the definitions of Ahmarian and Aurignacian as developed for the southern Levant.

In considering variability in Levantine Upper Palaeolithic assemblages, some approaches have treated technology in a typological manner. The emphasis on the typology (*e.g.*, blade or flake production) of the technological component of an industry does not account for the step-by-step procedures utilized in lithic reduction (*chaîne opératoire*). These procedures are often more sensitive indicators of cultural affiliation than tool forms that crosscut temporal and cultural boundaries. The following paper considers the significance of twisted debitage as an aspect of assemblages described as Aurignacian at Ksar Akil.

Some Terminological Considerations

Before considering the Levantine Aurignacian and twisted debitage, it is important to briefly mention some terminological issues. The following discussion should be regarded as a caveat rather than an attempt to resolve a debate that has been ongoing for more than 30 years.

In regard to artefact classification, the Levantine Aurignacian presents some unique problems. As an example, one needs only consider carinated scrapers and multi-faceted burins that are made on flakes and blades. Prehistorians commonly classify objects such as that illustrated in Fig. 15.1:4 as a tool, specifically a flat-faced carinated burin. However, it must be admitted that the 'spalls' detached could have served as blanks for the tiny retouched bladelets that are commonly found in Aurignacian assemblages. In this context, it is worth noting that Tixier and Inizan (1981: Figure 3) describe the tool type illustrated in Fig. 15.1:4 as a *burin nucléiforme plan*.

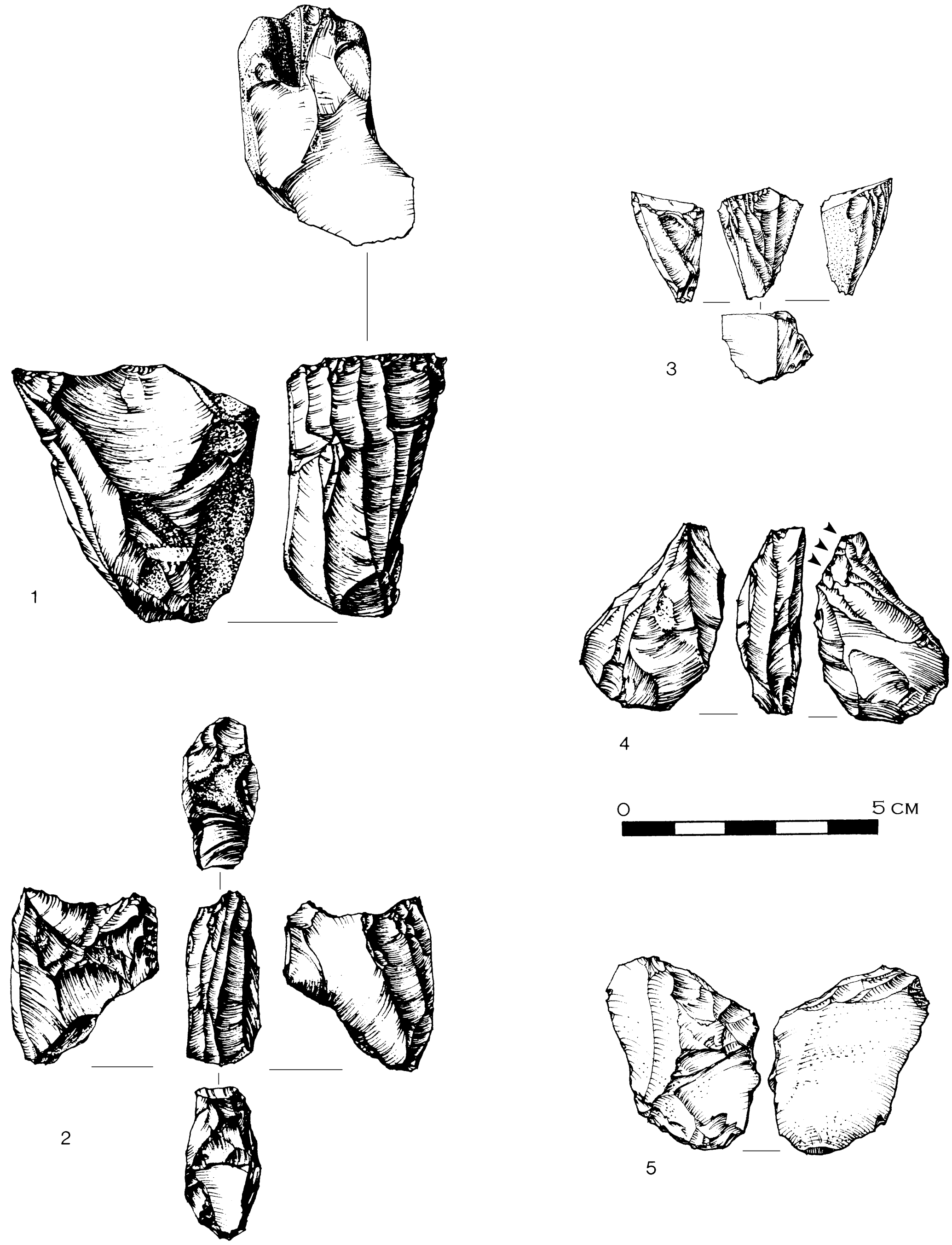


Fig. 15.1 Material from Ksar Akil Levels XIII–XI (1937–1938 excavations). 1, Blade core producing twisted debitage; 2, Bladelet core made on a flake; 3, Bladelet core; 4, Multi-faceted burin; 5, Lateral carinated scraper.

Were carinated scrapers and multi-faceted burins regarded as tools or cores, or were they treated as both? The answer to this question undoubtedly requires a multivariate answer that includes not just morphology, but technological and functional considerations as well (see also Belfer-Cohen and Grosman in press). It is also likely that the answer will vary from artefact to artefact, site to site, and culture to culture, making efforts to classify these pieces tentative at best.

It is also worth noting the problems surrounding the classification of el-Wad points, a 'type fossil' originally attributed to the Aurignacian (Belfer-Cohen and Bar-Yosef 1999), but later more prominently used to characterize the Ahmarian (Gilead 1981a, b). El-Wad points are basically blades or bladelets pointed by retouch. They involve relatively little manufacturing effort after blank production (when compared to a Solutrean laurel leaf or shouldered point, for example) and, according to Belfer-

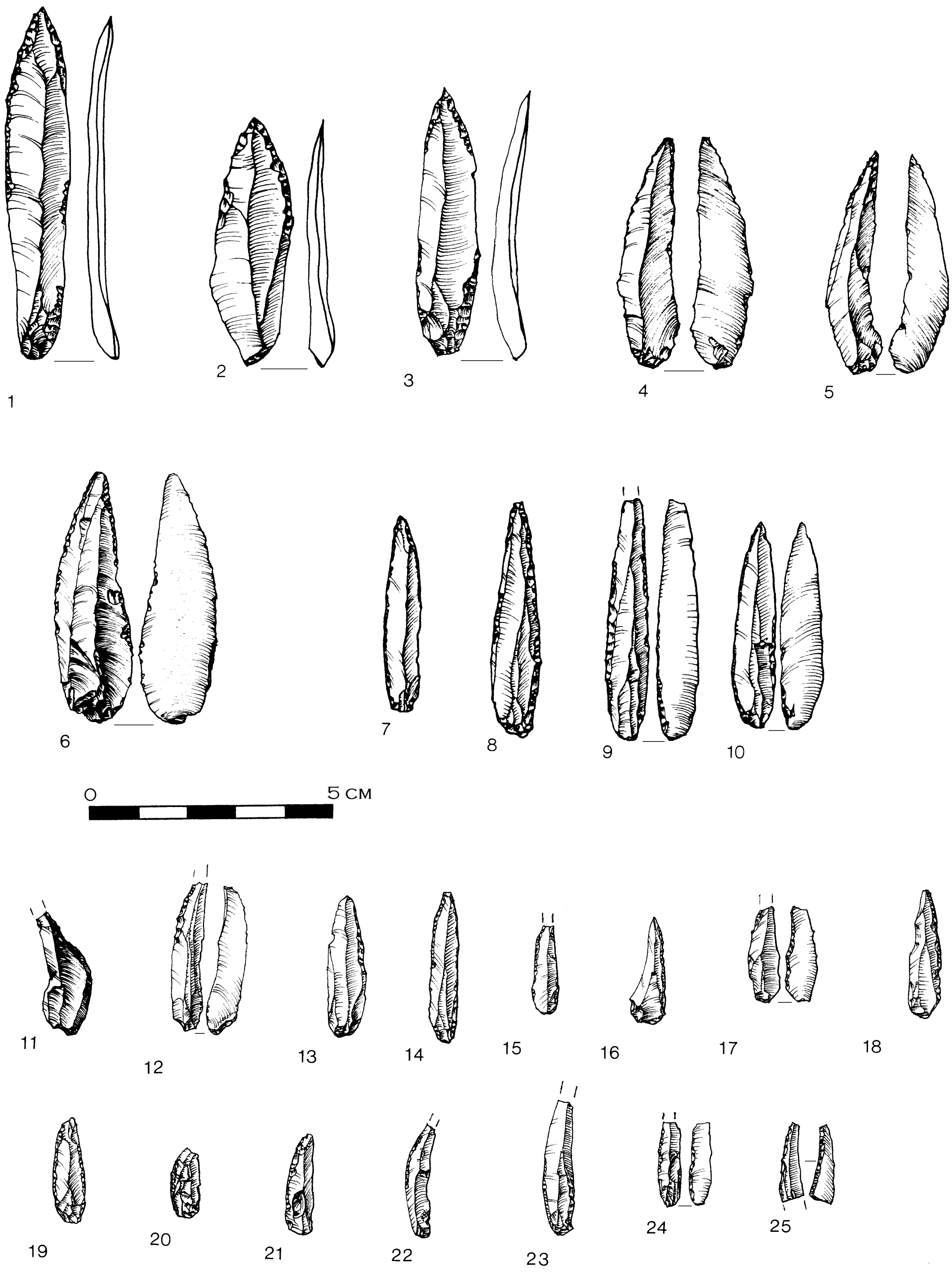


Fig. 15.2 Points grouped in the el-Wad cluster by Levantine prehistorians (1–10) and retouched bladelets (11–25) typical of Levels XIII–VI at Ksar Akil (1937–1938 excavations). 1–3, Points from Levels XX–XVI; 4–6, Points from Levels XIII–XI; 7–10, Points from Levels X and IX; 11–25, Retouched bladelets from Levels XIII–VI.

Cohen and Goring-Morris (this volume), betray the 'lazy Levantine spirit.'

The problems with the definition of the el-Wad point are obvious: it is too broad and recently several authors have included variants of the basic morphotype within it. In the southern Levant, the variants were considered compatible with the basic 'el-Wad cluster,' while in Lebanon, I. Azoury (personal communication 1977) preferred to assign a new name, the 'Abu Halka point,' to a distinctive, inversely retouched variant of the type (Fig. 15.2:9–10).

My own attempts (Bergman 1981) to clarify the termin-

ological situation surrounding the el-Wad point at Ksar Akil were not satisfactory. As Tixier rightly pointed out at the 1988 meetings held in Lyons, France, to commemorate the life and work of Francis Hours, the addition of so much variation in the definition of the el-Wad point rendered the term meaningless. However, during the analysis of point types from Ksar Akil (Bergman 1981) it became obvious that the 'el-Wad' points described for Ahmarian assemblages in the southern Levant (Gilead 1981b) were similar to the 'Ksar Akil' points (Fig. 15.2:1–3) described by Hours (1974) and Azoury (1986) in Lebanon. If the consensus is that the 'Ksar Akil' points of the Lebanese Early Ahmarian (Ksar Akil levels XX–XVI) are more properly termed 'el-Wad' points, then these are quite distinct from the twisted 'el-Wad' points that turn up in levels XIII–XI at Ksar Akil (Fig. 15.2:4–6). Perhaps the latter should no longer be called el-Wad points, but it must be remembered that points made on twisted debitage were used for the original type description by Dorothy Garrod in 1937 (Garrod and Bate 1937:48). If prehistoric 'lazy Levantines' were guilty of producing the el-Wad point, then it must be admitted that lazy Levantine prehistorians have been guilty of not applying rigorous taxonomic schemes.

The Levantine Aurignacian

A recent paper by Belfer-Cohen and Bar-Yosef (1999) provides an excellent summary of 60 years of research on the Levantine Aurignacian. Beginning in the 1930s, the criteria used to describe cultural changes and artefact types in Levantine prehistory were largely derived from western Europe. At Ksar Akil, J.F. Ewing called levels XX–XV 'Chatelperronian' (Ewing 1947) because of the large number of backed blades and bladelets, as well as what he regarded as Chatelperron points. By the 1960's, clear divergences between the European and Near Eastern sequences were recognized and terms more appropriate to the regional setting were adopted.

During the 1969 Wenner Gren Symposium held at the Institute of Archaeology, University of London, a number of prehistorians met to discuss the creation of a type list for the Levantine Upper Palaeolithic and Epipalaeolithic. In attendance was François Bordes who had been in London studying the collections from Ksar Akil. At the meeting, Bordes commented, 'I have studied some of these levels and see close similarities with the French Aurignacian, so close in fact that 'Aurignacian' seems the best term for them' (quoted in Bergman 1987a:8).

Refinement of the Levantine Aurignacian sequence was provided by the research of L. Copeland (1975) and F. Hours (in Besançon *et al.* 1977). They proposed a tripartite (A, B, C) division of the Aurignacian based on data collected from Ksar Akil. The earliest Aurignacian levels ('Levantine Aurignacian A,' Levels XIII–XI) were regarded as unique to Ksar Akil with el-Wad points and flat-faced carinated burins. 'Levantine Aurignacian B' (Levels X–VIII) was said to show an increase in Aurignacian elements and el-Wad points, while 'Levantine Aurignacian C' (Levels VII–V) contained bladelets, numerous prismatic burins, and carinated scrapers (Belfer-Cohen and Bar-Yosef 1999).

In the 1970s and early 1980s, extensive fieldwork in the southern Levant resulted in new paradigms for Near Eastern prehistorians to consider. Marks (1981a) and Gilead (1981a, b) recognized two assemblage types in the semi-arid regions of the southern Levant. One of these, the Ahmarian, was technologically blade-focused with a tool kit composed primarily of el-Wad points and retouched blades/bladelets along with fewer endscrapers and burins. The Aurignacian was described by Gilead (1981a:339) as '… technologically dominated by the production of flakes over blades and typologically by the end-scrapers (steep or flat), the burins or both (>*ca.* 50%) as well as low quantities of blade and bladelet tools (*ca.* 20%).'

The definition of the Aurignacian developed in the southern Levant posed significant problems as it excluded assemblages reported from the Mediterranean coastal zone traditionally regarded as Aurignacian. Nowhere was this more evident than at Ksar Akil where a series of levels contained Aurignacian tool types with a technological emphasis on blade and/or bladelet production (Ronen 1976; Besançon *et al*. 1977; Tixier and Inizan 1981; Mellars and Tixier 1989; Ohnuma and Bergman 1990:132–133; Marks 1990:73).

Ksar Akil Levels XIII–VI

Ksar Akil has the longest Upper Palaeolithic sequence recorded for any site known in the Levant. While research at the site has been important in clarifying chronostratigraphic relationships during the Upper Palaeolithic, its long sequence has also been utilized as a kind of '*fossile directeur*' for cultural developments throughout the region. If one thing was clear after the 1988 meeting held in Lyons, it was that this notion was wrong. The amount of data provided by participants at this meeting (summarized in Bergman 1988b) suggested that assemblage variability over a relatively small area was considerable, certainly more than could be accommodated for by any single site or locality.

The following discussion uses data collected during the 1937–1938 excavations of Ksar Akil conducted by a team from Boston College, Massachusetts (see Copeland 1987:iv–ix for details). The excavations in 1937–1938 were conducted in 2 m² units and reached a depth of some 19 m. While the excavators did not use three-dimensional plotting of individual artefacts, they did attempt to follow the natural stratigraphy and the sediments were screened (see Bergman 1987a: Plate 19). World War II interrupted work at the site and excavations were not resumed until 1947–1948. The material collected in 1947–1948, currently housed at the Peabody Museum, Harvard University, has never been published in detail and it is

Table 15.1 Nomenclature Applied to Levels XIII–XI at Ksar Akil.

Ksar Akil Levels (1937–1938 excavations)	Besançon *et al*. (1977)	Bergman & Ohnuma (1990)	Belfer Cohen & Goring-Morris (this volume)
XIII–XI	Levantine Aurignacian A	Ksar Akil Phase III	?
X–IX	Levantine Aurignacian B (includes X–VIII)	Ksar Akil Phase IV	?
VIII–VII	Levantine Aurignacian C (includes VII–V)	Ksar Akil Phase V	Levantine Aurignacian
VI	Levantine Aurignacian C	Ksar Akil Phase VI	Atlitian

unknown whether the same stratigraphic designations utilized in 1937–1938 were applied.

The earliest recognized Upper Palaeolithic levels (XXV–XXI) at Ksar Akil are regarded as 'Transitional' and appear to be later in date than the earliest material described from Boker Tachtit (Marks 1983c). In level XX, there is a shift toward intensive blade production from single or opposed platform cores with a tool assemblage composed of retouched blades and el-Wad points. Levels XVII and XVI, in particular, contain significant numbers of robust el-Wad points (the 'Ksar Akil' points of Azoury 1986; Ohnuma 1988) with relatively few burins (Newcomer 1972) and endscrapers. In addition, the skeletal remains of an anatomically modern juvenile, aged 7–9 years at the time of death (Bergman and Stringer 1989), were recovered from Level XVII. Above level XVI, there is a disturbed layer (level XV) followed by a major occupational hiatus in level XIV (Azoury 1986:172). This break in the sequence separates the Early Ahmarian assemblages (levels XX–XVI) from those designated as Aurignacian (XIII–VI).

Ksar Akil levels XIII–VI comprise the portion of the stratigraphic sequence that has traditionally been designated the Levantine Aurignacian. Since opinions vary as to how the sequence is described and divided, Table 15.1 lists the subdivisions and nomenclature applied by several authors to levels XIII–VI.

There is widespread agreement that levels XIII–XI represent a grouping of related assemblages (originally termed 'Levantine Aurignacian A') characterized by a higher percentage of burins than endscrapers. Multi-faceted burins and carinated scrapers make up between 15% and 28% of the assemblages, while retouched blades and bladelets and twisted el-Wad points account for up to 17% (Fig. 15.2:4–6). As indicated in Table 15.2, blades and bladelets outnumber flakes in the debitage sample.

Multiple reduction strategies are evidenced in levels XIII–XI by blade cores, bladelet cores, bladelet cores made on flakes, as well as multi-faceted burins that could have also produced tool blanks (Fig. 15.1). A significant feature of blade and bladelet production is the percentage of blanks with twisted profiles. The percentage of twisted blades and bladelets never falls below 55% in any of the

Table 15.2 Percentage of Debitage Types for Levels XIII–XI.

Level	Number	Flakes %	Blades %	Bladelets %
XIII	358	42.46	41.06	16.48
XII	2953	30.44	63.53	6.03
XI	3842	48.54	36.34	15.12

excavation units examined within levels XIII–XI. While some twisting of blade and bladelet profiles can occur randomly in any assemblage, the high percentages of twisted profiles and the morphology of the cores suggest this trait was intentional.

Levels X and IX differ from levels XIII–XI in a number of important aspects. First, there is a decrease in the number of multi-faceted burins and carinated scrapers to around 11%. There is an increase in the numbers of el-Wad points and el-Wad variants with proximal inverse retouch (Azoury's 'Abu Halka' point). The points from levels X and IX are not made on twisted blanks, but rather on narrow blades and bladelets with straight or slightly curved profiles. The type of blanks manufactured and selected to produce these points creates a dramatic morphological contrast with the twisted el-Wad points of levels XIII–XI (compare Fig. 15.2:4–6 with 7–10). This fact calls into question the wisdom of lumping all variations on the theme of 'blade or bladelet pointed by retouch' into a single type designation.

There are separate reduction strategies for blades and bladelets, while twisted debitage averages roughly 30% of the material examined in levels X and IX. Bladelets numerically dominate, comprising nearly 40% of the debitage in both levels (Table 15.3; Ohnuma and Bergman 1990:120). Bladelets were produced by a variety of reduction scenarios (Fig. 15.3) with the larger examples detached from blade cores that produced progressively smaller blanks during the course of reduction. In addition, bladelets were obtained from cores initially set up specifically for bladelet reduction. Finally, tiny bladelets were detached from artefacts classified as multi-faceted burins and carinated scrapers.

Table 15.3 Percentage of Debitage Types for Levels X and IX.

Level	Number	Flakes %	Blades %	Bladelets %
X	9926	26.99	33.77	39.24
IX	31019	42.18	18.52	39.30

Table 15.4 Percentage of Debitage Types for Levels VIII and VII.

Level	Number	Flakes %	Blades %	Bladelets %
VIII	6413	73.34	13.55	13.11
VII	5115	90.24	8.35	1.41

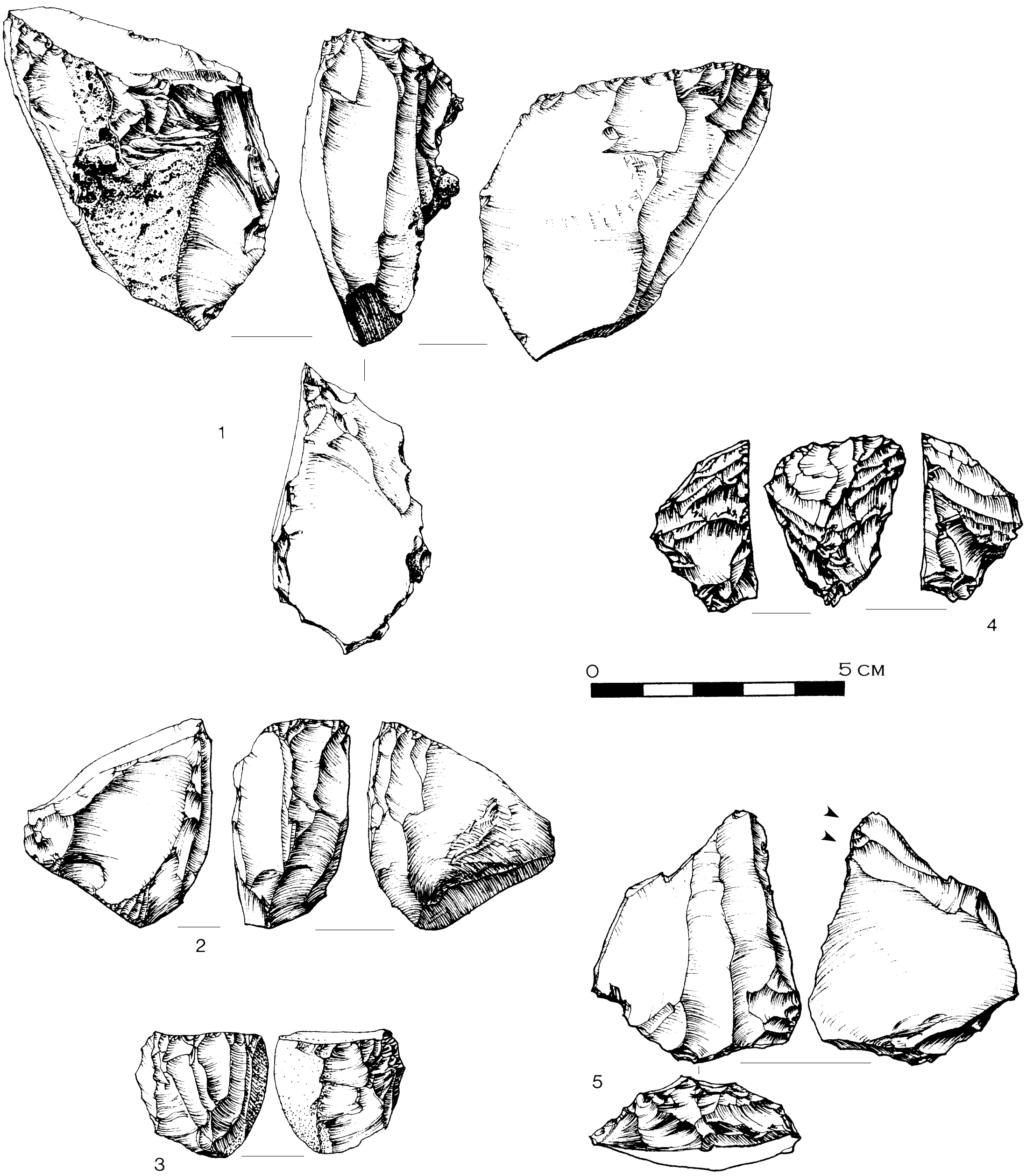


Fig. 15.3 Material from Ksar Akil Levels X and IX (1937–1938 excavations). 1, Blade core; 2, Bladelet core made on a flake; 3, Bladelet core; 4, Carinated scraper; 5, Multi-faceted burin.

No radiocarbon dates exist for Levels X and IX of the 1937–1938 excavations, however, a date of 32,000±1500 bp (MC-1192) was obtained from *couche* 12m (Phase VII) of Tixier's excavations (Mellars and Tixier 1989). Tixier's Phase VII is believed to occur within the same portion of the Ksar Akil sequence as Levels X and IX of the Boston College excavations.

Besançon and others (1977) originally designated levels X–VIII as 'Levantine Aurignacian B.' While agreement exists that levels X and IX may be grouped together, the inclusion of level VIII is problematic. Levels VIII and VII represent a major technological shift in the Ksar Akil sequence. For the first time, flakes dominate the sample of debitage (Table 15.4), comprising 73.3% and 90.2%, respectively (Dortch 1970:183; Bergman 1987a). Blades and bladelets occur in significantly reduced percentages, an observation that is both real and, at the same time, exaggerated by the 1937–1938 excavation and recovery techniques. Typologically, levels VIII and VII have the highest Aurignacian index (including tools such as Aurignacian blades and carinated or nosed scrapers) recorded for the Ksar Akil sequence at 39.3 and 42.5, respectively.

Based on the results of the 1969–1974 excavations, it would appear that the percentage of bladelets is under-represented in the 1937-1938 collection. While Phase VI of Tixier's excavations (*couche* 10h[1] – 11c), believed to broadly correspond with levels VIII and VII (Bergman and Goring-Morris 1987), does display a decrease in tools made on bladelets, they still make up 21% of the assemblages (Tixier and Inizan 1981: Table 1). The retouched bladelets include '… *un type inconnu jusqu' alors: très petite, 'en virgule'*.' The blanks for these tiny, 'comma-shaped,' tools, also referred to as Dufour bladelets in Europe and the Near East, probably came from small bladelet cores, some made on flakes rather than tabular blocks or small nodules, as well as artefacts classified as carinated scrapers and multi-faceted burins. Scrapers, in particular the nosed, shouldered, and carinated types (Fig. 15.4:4–7), are common in Tixier's Phase VI and levels VIII and VII of the 1937–1938 excavations (Tixier and Inizan 1981:360; Bergman 1987a).

One other component of the levels VIII–VII assemblages bears consideration. Over 70% of the 131 bone and antler tools recovered from the 1937–1938 excavations were recovered from these levels (Newcomer 1974). The standard forms for these tools are simple, basically awls and points with small tangs or bi-pointed ends (Fig. 15.4:8–10). Mark Newcomer (1987:289) believed that the raw material available for manufacture, long bones and antler from animals like roe (*Capreolus* sp.) and fallow (*Dama* sp.) deer, dictated point morphology. Roe and fallow deer antler have a relatively thin layer of compact tissue that was best suited for points with flattened cross-sections. Long bones from these animals would have provider thicker raw material suitable for the rounded-section pieces with bi-pointed ends. It is likely that raw material availability explains the general scarcity of robust split-based points, similar to those found in the European Aurignacian, which relied on thicker-walled reindeer (*Rangifer tarandus*) antler.

Two dates have been published from Phase VI of Tixier's excavations (Mellars and Tixier 1989). An AMS date from *couche* 10i yielded a determination of 31,200±1,300 bp (OxA-1804), while another AMS determination from *couche* 11bm was 32,400±1,100 bp (OxA-1805). When considered with the date from Tixier's Phase VII, this portion of the Ksar Akil sequence, broadly comparable to Levels X–VII of the 1937–1938 excavations, dates to somewhere between 30,000 and 33,500 bp. It is reasonable to assume that levels XIII–XI, traditionally called 'Levantine Aurignacian A,' could be as old as 37,000 bp.

Level VI at Ksar Akil, although regarded as part of 'Levantine Aurignacian C' by Besançon and others (1977), was considered distinct from level VII by the present author (Bergman 1987a; Ohnuma and Bergman 1990:130). This layer is the only one to contain burins on Clactonian notches (Fig. 15.5:5–6) and it displays nearly equal proportions of flakes (50.6%) and blades and bladelets (49.4%). Numerous tiny retouched bladelets, many with twisted profiles, occur in the sample and these were detached from bladelet cores, as well as pieces classified as multi-faceted burins and carinated scrapers (Fig. 15.5).

While Level VI has been treated as distinct from the Aurignacian by myself and other scholars (*e.g.*, as the 'Atlitian' by Goring-Morris and Belfer-Cohen, this volume), Tixier did not identify any breaks in the Ksar Akil sequence and regarded the Aurignacian as evolving *in situ* (Tixier and Inizan 1981). As Mellars and Tixier (1989:762) observed, '…our impression, however, is that the bladelet dominated industries of Phases V–I could well have directly developed from the typical 'Levantine Aurignacian' industries of Phases VI and VII.'

Technology of Twisted Blades and Bladelets

During the 1987 roundtable conference in London, the author showed Jacques Tixier some blade cores from levels XIII–XI that had produced twisted debitage. He remarked... 'The twisted debitage, it continues through the whole sequence.'

Blade technologies show great variation across temporal and cultural boundaries. It goes without saying that the blades produced by the Lagaman people (Bar-Yosef and Belfer 1977) differ from those produced by the Palaeoindians of North America (Collins 1999) to use an extreme example. Variations occur in the manner of core preparation (*e.g.*, cresting); the mode of blank detachment (*e.g.*, pressure, hard or soft percussion); the method of blank detachment (*e.g.*, direct or indirect percussion); the manner in which the striking platform is prepared (*e.g.*, faceting or single flake removal) or rejuvenated (*e.g.*, core

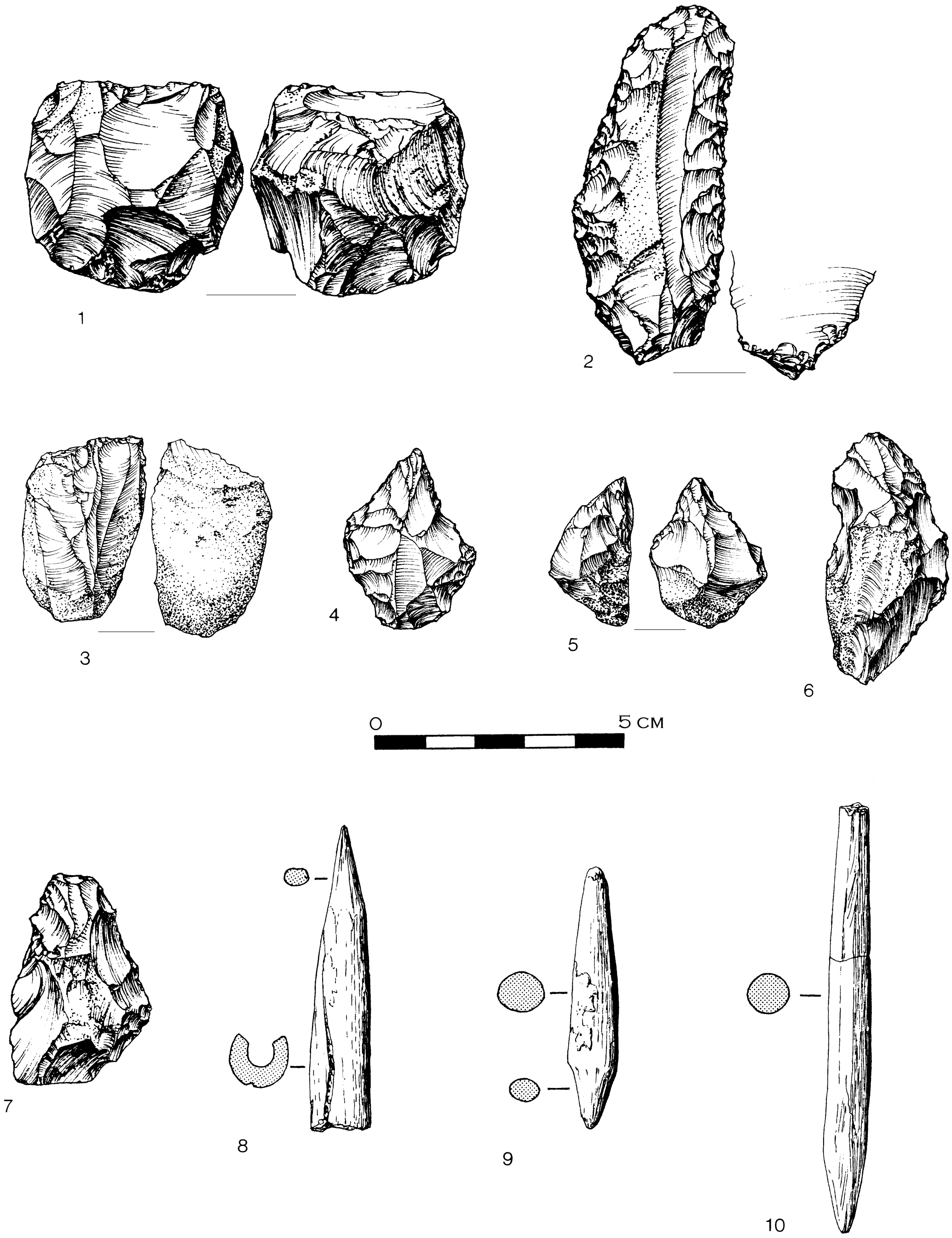


Fig. 15.4 Material from Ksar Akil Levels VIII and VII (1937–1938 excavations). 1, Flake core; 2, Aurignacian blade; 3, Bladelet core; 4–7, Nosed and carinated scrapers; 8–10, Bone/antler tools including an awl, a tanged point, and a rounded-section point (after Newcomer 1974).

tablet or faceting); and the character of the blanks produced. Thus, to characterize assemblages simply by the fact they are 'bladey' reveals nothing of the various technological nuances that precisely define approaches to lithic reduction.

In the sample from levels XIII–VI of the 1937–1938 excavations, blades, bladelets, and tiny bladelets with twisted profiles were detached from the following: blade cores; bladelet cores; multi-faceted burin types; and a variety of scrapers including the nosed, carinated, and lateral carinated types.

The production of twisted blades and bladelets almost always involves unidirectional flaking. One of the key features of producing twisted debitage is the point on the striking platform at which the blow is struck. Instead of aligning the percussor behind a ridge along the central

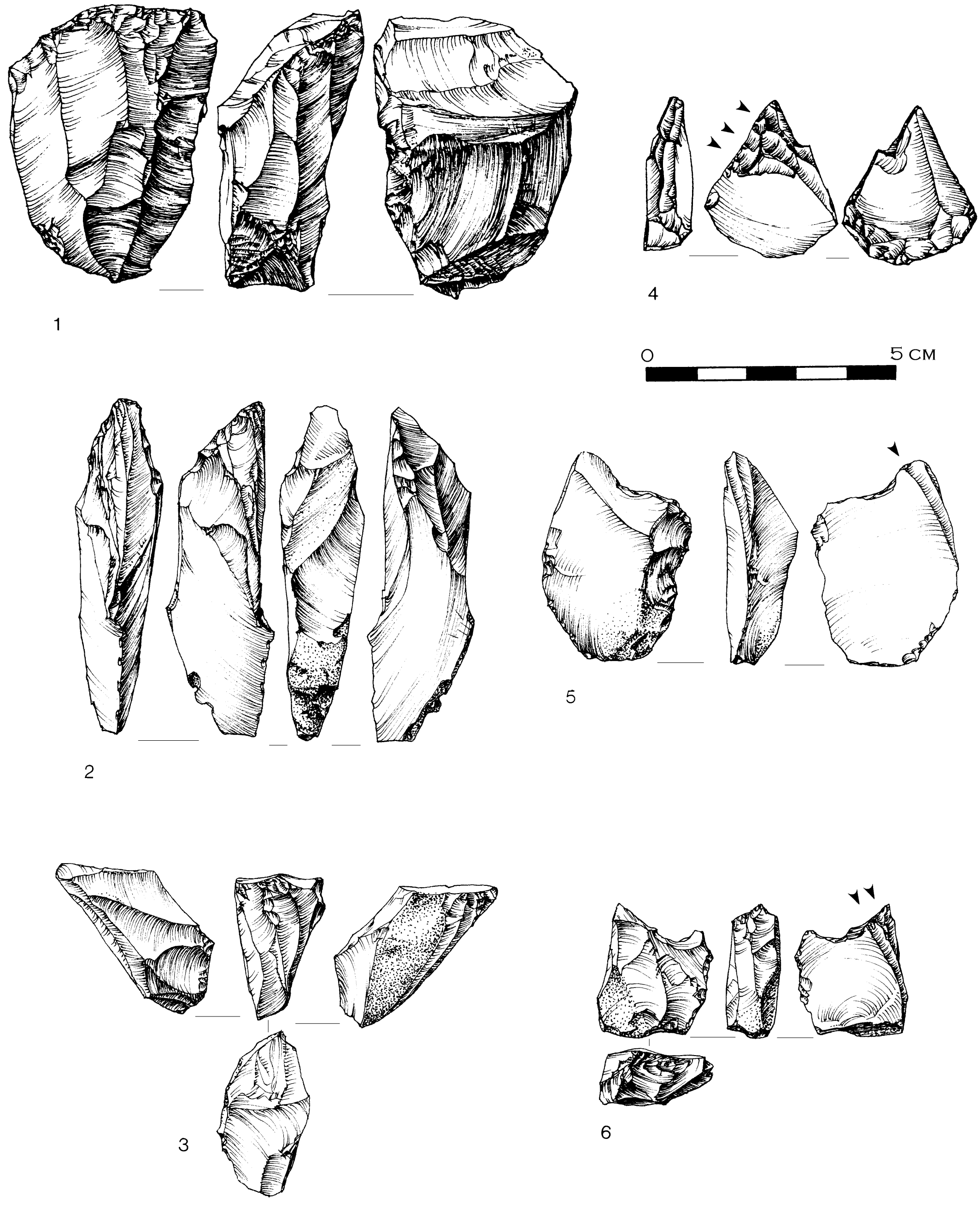


Fig. 15.5 Material from Ksar Akil Level VI (1937–1938 excavations). 1, Blade core; 2, Bladelet core made on a flake; 3, Bladelet core; 4, Endscraper and multi-faceted burin; 5–6, Burins on notches.

axis of the core, the blow is struck on the side of the striking platform, offset to a central ridge. As the force of the blow travels down the side of the core it intersects a ridge or ridges on the central axis and twists out to the front of the core. The results of this effect can be seen in Fig. 15.1:1.

The striking platform of a core producing twisted debitage is generally angular in plan shape, rather than semi-circular, and it is offset to the flaking face. Due to the position at which the blow is struck, twisted blades and bladelets have an axis of percussion that is offset to their long axis. Twisted blades and bladelets generally have converging lateral edges due to the relatively narrow shape of the core's flaking face. This promotes pointed distal ends and provides the blank with the 'comma-like' appearance noted by Tixier and Inizan (1981). In the samples examined from Ksar Akil, twisted blades and bladelets were detached exclusively by soft hammer and

have tiny, plain butts indicative of a hammer blow close to the platform edge.

In the 1937–1938 Ksar Akil collection, there was a marked trend noted in the direction of the twist. The vast majority of blades and bladelets examined in levels XIII–XI, for example, twist toward the right lateral edge (Bergman 1987a:16–63), a fact that may be indicative of the hand used to hold the core during knapping.

Conclusions

After the stratigraphic hiatus in level XIV at Ksar Akil, there are a series of assemblages that have been designated as Levantine Aurignacian. Regardless of how the sequence at Ksar Akil is subdivided or whether it is regarded as continuous, there is agreement that the first assemblages (levels XIII–XI) to be called Aurignacian at the site possess a distinctive technological characteristic. They all contain significant numbers of blades and bladelets with twisted profiles (>50%). Twisted debitage continues throughout levels X–VI with fluctuations in percentages, but averaging about 31% (the range is between roughly 20% and 40% for the sample examined). It seems that any attempt to describe the Levantine Aurignacian should take account of the presence of twisted debitage.

Ksar Akil levels XIII–VI also display a profoundly different approach to lithic reduction when compared to the preceding Early Ahmarian levels XX–XVI. Perhaps the most significant departure is in the number and type of blade and bladelet lithic reduction strategies (Figs. 15.1, 3–4). These may be characterized as follows:

Some cores were initially prepared to produce blade-size blanks (Figs 15.1:1 and 3:1), while other cores (Figs. 15.1:3 and 3:3 for example) were clearly set up to produce bladelets; Flakes were detached during general core preparation or intentionally from flake cores and some were selected for preparation into cores for blade and bladelet manufacture (*e.g.*, core on a flake, Figs. 15.1:2 and 3:2); Multi-faceted 'core-like' burins (Fig. 15.1:4) produced tiny bladelets; and carinated as well as various other scraper types (Fig. 15. 4:4–7) also produced tiny bladelets.

Evidence for each of these reduction strategies can be found within Ksar Akil levels XIII–VI. However, the debitage types vary within each grouping of levels. For example, levels XIII–XI appear more focused on twisted blade production, whereas twisted debitage in levels X and IX was more frequently associated with bladelet production. Despite these differences, it is clear that multiple reduction strategies are a feature of the technological repertoire beginning with the earliest manifestation of industries called Aurignacian at Ksar Akil.

The grouping of levels XIII–VI under the term Levantine Aurignacian was originally based primarily on typological considerations. The presence of Aurignacian tool types, such as carinated scrapers and burins, nosed and shouldered scrapers, and Dufour bladelets suggested to many, including François Bordes, that 'Aurignacian' was an appropriate label for these industries. In spite of this fact, debate has continued surrounding what constitutes the Levantine Aurignacian at Ksar Akil and, indeed, the entire Levant. According to Anna Belfer-Cohen (personal communication 2001), most prehistorians agree that the definition of the Levantine Aurignacian should be reserved for material more closely resembling the classic European Aurignacian such as Kebara D, Hayonim D, el-Wad D, and Ksar Akil levels VIII–VII. This opinion suggests that little has changed over the past decade with assemblages such as Ksar Akil levels XIII–IX still relegated to a taxonomic 'limbo' (Bergman and Goring-Morris 1987; Ohnuma and Bergman 1990:133).

Regrettably, this paper does little to dispel the taxonomic problems surrounding the Levantine Aurignacian. However, the following comments may provide some direction for future consideration of the issue:

At the 1988 Lyons conference, Bar-Yosef remarked that '…we should keep in mind that we are playing with our own definitions and from time to time we should sit down and redefine what we really mean by using a certain taxon' (quoted in Bergman 1988b:227). During the past two decades it has sometimes seemed like the debate over characterization of prehistoric cultural affinities has amounted to little more than 'playing with our own definitions.' The continuing use of the term Aurignacian implies connections with the eponymous European culture and demands efforts to determine the nature of this relationship.

Detailed technological studies, using the *chaîne opératoire* approach, would help to clarify the choices made by Levantine Aurignacian peoples during all stages of lithic reduction. To date, no comprehensive comparison of lithic technology involving the European Aurignacian and Levantine Aurignacian has been undertaken. Such a study may help to resolve issues related to cultural affinity beyond simple reference to artefacts of similar appearance. The research could be expanded to account for the technology of bone and antler working as well, especially since split-based points have been recovered from Kebara, Hayonim, and el-Quseir (Belfer-Cohen and Bar-Yosef 1999).

Copeland (1987:iv) commented that our current definition of the Levantine Aurignacian '… does not account for technical and typological variability such as is seen in the West European Aurignacian.' Levels VIII and VII at Ksar Akil have a temporal placement toward the end of a longer sequence of levels that have traditionally been called Aurignacian. It is imperative to try and understand the relationship between those assemblages accepted as Aurignacian (*e.g.*, Ksar Akil VIII and VII) and those assemblages (*e.g.*, Ksar Akil XIII–IX) that display some Aurignacian characteristics but are currently excluded from the taxon.

In regards to specific lithic reduction methods, twisted

debitage (blades, bladelets, and tiny bladelets) appears at Ksar Akil in significant percentages beginning with those assemblages traditionally described as Aurignacian. One direction for future Aurignacian studies should be to test the validity of this correlation in other parts of the Levant.

The taxonomy of the Levantine Aurignacian is clearly a multidimensional problem. This paper has indicated that the presence of Aurignacian tool types along with twisted debitage, the utilization of multiple reduction strategies, and later the presence of bone and antler tools, together form the identity of industries originally described as Aurignacian at Ksar Akil. It is evident that any definition of the Levantine Aurignacian must account for a complex suite of characteristics that does not lend itself easily to a shorthand formula (*e.g.*, the ratio of flakes to blades or the percentages of tool types) such as that proposed previously.

Acknowledgements
This paper is the result of 10 years of reconsidering the Levantine Aurignacian at Ksar Akil and it is based, in part, upon conversations with Lorraine Copeland, Francis Hours, Anthony Marks, Jacques Tixier, Ofer Bar-Yosef, Anna Belfer-Cohen, Isaac Gilead, and Nigel Goring-Morris among others. I am especially indebted to Anna and Nigel for their comments on this text. While these colleagues have played an important role in developing my thoughts on the Aurignacian, the opinions expressed are my own.

16. An Examination of Upper Palaeolithic Flake Technologies in the Marginal Zone of the Levant

John K. Williams

Introduction

The marginal zone of the Levant has received considerable attention by researchers of prehistory during the past 30 years, compared to the early part of the 20th century, when pioneering research was primarily restricted to the Mediterranean core zone. A wealth of information has been provided by discoveries in the Negev, Sinai, and western Jordan. While new excavations continue to provide important information, there is still plenty to be learned from prior findings. Arguably, it has become necessary to restudy some of these assemblages, because our knowledge about them is not sufficient to address many of the pressing issues in Levantine Upper Palaeolithic research. The following analysis takes another look at a group of assemblages that were first published some 25 years ago. While the primary research objective when these assemblages were discovered was to create a descriptive framework to include the new findings, the impetus for their restudy today is different. The current challenge is to clarify some aspects of the original frameworks, and to test the validity of their implications. This is attempted by fashioning a methodology that derives information relevant to current issues of interest to Upper Palaeolithic research, thus furthering the utility of the material. To this end, the analysis proceeds as follows: (1) by tailoring the analytical procedures to issues concerning the concept of 'Levantine Aurignacian'; (2) by comparing aspects of the sample group with published information from assemblages located in different phytogeographic zones; and (3) by using different frames of reference (*e.g.*, environmental variables) to observe higher-order derivative patterning.

Background and Research Objectives

Beyond sharing the same name and broad techno-typological similarities, the scale of affinity among assemblages currently labeled 'Levantine Aurignacian' is largely unknown, particularly between those from the core and marginal zones, but also within each area. The term 'Aurignacian' was originally used for Levantine assemblages on the basis of their similarity to the European Upper Palaeolithic (Garrod 1953). In 1969 at the London Conference, a decision was made to preface the term Aurignacian with 'Levantine' in order to emphasize its specific characteristics at sites confined to the central and northern Levant (Copeland 1970:106; Gilead 1981a: 339). In an attempt to describe new data arising from extensive fieldwork in the southern Levant during the mid-1970's, Gilead (1981a) and Marks (1981a) independently proposed an expanded descriptive framework, which suggested that two traditions co-existed in the Levant: (1) the 'Levantine Aurignacian'; and (2) the 'Ahmarian'. In the broadest sense, the two-tradition framework described the Levantine Aurignacian as a flake-dominated tradition and the Ahmarian as being dominated by blades and bladelets. More specifically, southern, marginal zone assemblages were classified as Levantine Aurignacian on the basis of a technology that involved the use of carination, the primary production of flakes that were used for tool blanks (Marks 1977b, 1981a), and a typology that was dominated by endscrapers and burins (Gilead 1981a). Both Gilead and Marks described the Ahmarian as an elaborate blade-bladelet technology with a toolkit composed mainly of retouched and backed blades, as well as el-Wad points.

This study presents an analysis of seven assemblages from the marginal zone, specifically from the central and western Negev highlands (Fig. 16.1). Each of these assemblages was excavated during the Central Negev Project (1969–1983), directed by A. E. Marks. Reports for these assemblages were published in the first two volumes of *Prehistory and Paleoenvironments in the Central Negev* (Marks 1976a; 1977a). Five of the assemblages considered for this study are located in the Avdat/Aqev area of the central Negev Highlands. Ein Aqev (D31) is situated in the Nahal Aqev, and consists of 60 cm of stratified cultural deposits. A hearth from Ein Aqev was radiometrically dated to the end of the Upper Palaeolithic, *ca*. 17,500 bp (Marks 1976b). Flanking the rim of the Nahal Zin canyon, Sde Divshon (D27B) is a

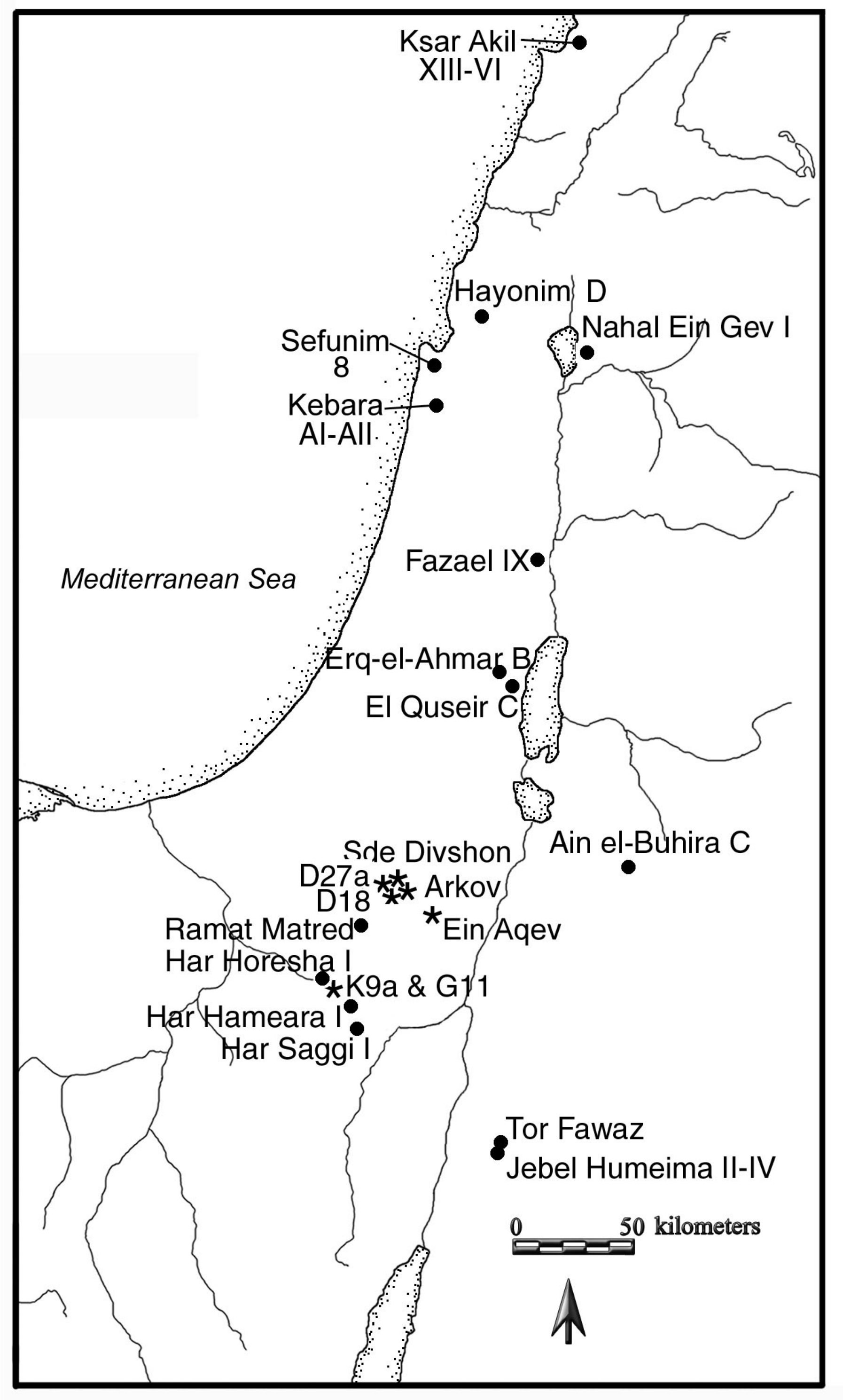


Fig. 16.1. Flake-dominated assemblages, and assemblages classified at one time or another as Levantine Aurignacian within the southern and central Levant (sites marked with an asterisk indicate those used in this analysis).

surface and *in situ* concentration of lithic artefacts covering an area of *ca*. 800 m². While the lithic assemblage was classified as Ahmarian by its excavator, Gilead considered it to be characteristic of the Levantine Aurignacian (compare Gilead 1981a:340, Table 1; Marks 1981a:347, Table 2). Excavations and surface collections at three other sites in the central Negev Highlands, Arkov (D22A), D27A, and D18 revealed abundant surface and shallow subsurface lithic artefacts. These assemblages were incorporated into the two-tradition framework as

Table 16.1. Detailed type list used in analysis.

1. simple endscraper	15. burin on concave truncation
2. unilateral endscraper	16. multiple dihedral burin
3. bilateral endscraper	17. multiple burin on truncation
4. double endscraper	18. multiple burin on truncations
5. nosed scraper	19. multiple mixed burin
6. shouldered scraper	20. el-Wad point
7. ogival endscraper	21. retouched blade
8. scraper on retouched piece	22. bladelet Dufour
9. sidescraper	23. notch
10. dihedral burin on snap	24. denticulate
11. dihedral burin on natural surface	25. truncation
12. dihedral angle burin	26. retouched piece
13. burin on straight truncation	27. backed piece
14. burin on convex truncation	28. other

Table 16.2. General sampling information for each assemblage.

Collection	Total Debitage (n)	Total Cores (n)	Total Tools (n)	Sampling Procedure	Total Sampled Artefacts (n)
Ein Aqev (D31)	8,981	272	1,287	B[1]	669
Sde Divshon (D27B)	17,105	1,303	1,529	B[2]	667
Arkov (D22)	3,463	227	314	A[1]	521
D27A	1,967	115	457	A[1]	501
D18	1,279	99	209	A[1]	425
K9A	2,446	171	222	A[1]	553
G11	2,164	226	266	A[1]	615

A[1]. Random sample of debitage from all available units in each level; all available cores and tools.
B[1]. Random sample of debitage from all available units in each level; all tools of certain classes; random sample for remaining cores and tools.
B[2]. Random sample of debitage from all available units in each level (or surface); random sample of all available cores and tools.

marginal zone representatives of the Levantine Aurignacian (Gilead 1981a; Marks 1981a).

In addition, two surface assemblages studied for this analysis, K9 and G11, were found on Har Harif, atop the highest plateau in the central Negev Highlands. These sites possess a flake technology, and a toolkit with high percentages of ‘Aurignacian’ elements (carinated scrapers and burins) (Larson and Marks 1977).

Methodology

At one time or another, each of these assemblages has been broadly classified as Levantine Aurignacian by various researchers. The methodology used here examines how they might compare among themselves, and to the broader Levantine Upper Palaeolithic classificatory scheme. In order to test the degree of inter-assemblage affinity, attributes and criteria were chosen which detail core reduction strategies and tool manufacture and discard, within a framework that considers the properties of the Levantine Aurignacian, as it has been defined previously. According to the most frequently cited characteristics, the Levantine Aurignacian is defined by specific technological attributes (carination, thick blade blanks and Aurignacian retouch), in addition to specific typological attributes at the class and type levels (thick and steep scrapers, nosed and shouldered scrapers, multifaceted burins, el-Wad points and bone/antler tools). The methodology was created with these characteristics in mind, proceeding from a basic division into class types, to more detailed information about blank types and scar patterns, and finally to metric measurements. The type list (Table 16.2) was created using the relevant tools from well-established typologies found in a number of publications for Europe and the Levant (de Sonneville-Bordes and Perrot 1954–1956; Brézillon 1971; Hours 1974; Marks 1976c:378–382; Goring-Morris 1980a:45–46; Bergman 1987a:6–15).

Of particular importance in this methodology is a subcategory of ‘carinated pieces’, which includes both cores and tools. The treatment of carinated lithic implements in this study attempts to avoid some of the problems that arise when using typologies that include carinated tools. Many efforts have been made to classify carinated

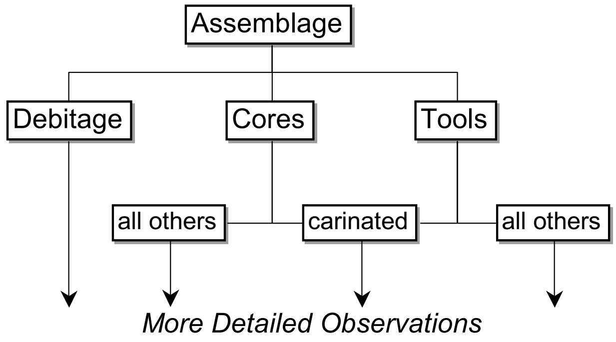


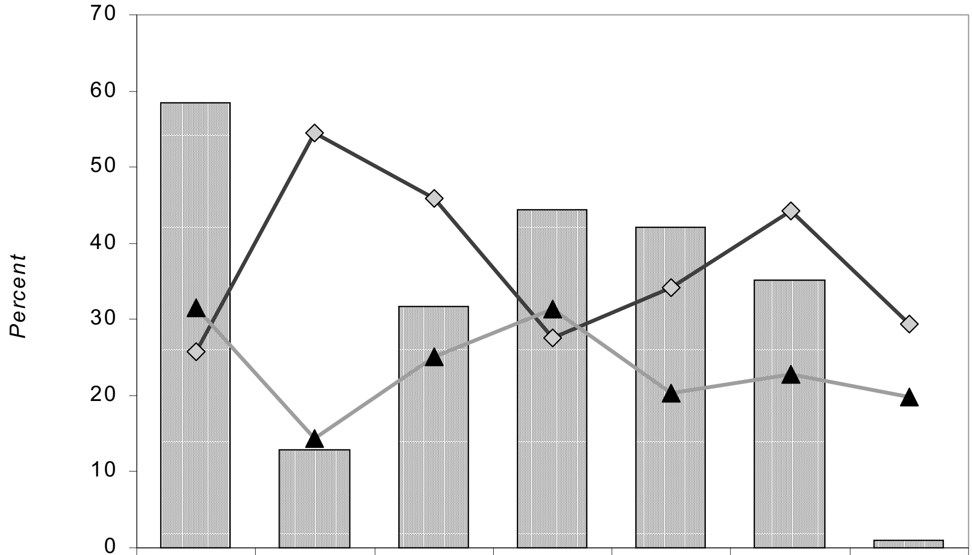
Fig. 16.2. Process of dividing each assemblage into analyzable units.

artefacts in western Europe and the Near East. The term 'carinated scraper' was first used by Breuil (1906:340), who defined this tool on the basis of the convex shape of the contour, *i.e.*, the profile of the working edge, and the thickness of the blank. The earliest classifications of carinated burins (Noone 1934:478; Bouyssonie 1948:16) also emphasized the convex, or keeled shape of the burin spalls visible in their profile. Since the inclusion of carinated tools in lithic typologies, archaeologists have struggled to define the boundaries between carinated burins, carinated scrapers, and cores. Some have proposed the term 'core-tools' to deal with the intermediate forms (*e.g.*, de Sonneville-Bordes and Perrot's [1956:412] 'core-like burin'), while others such as F. Bordes argued against tool-core hybrids, stating that an artefact '… is a core or a scraper, not both' (quoted in Bergman 1987a:12). Recognizing the impracticality of distinguishing many carinated tools from cores, Goring-Morris (1980a:45–46) eliminated a number of carinated tool types on Bar-Yosef's type list (1970:18–19) and re-classified them as cores, reserving the terms 'carinated burin' and 'carinated scraper' to implements on flake blanks. Bergman (1987a:12) further reduced the number of carinated tools in his typology for Ksar Akil by using Goring-Morris's restriction to artefacts produced on flakes (or blades), in addition to combining the carinated burin and scraper classes into one tool type: 'carinated pieces.'

Similarly, the methodology used in this study attempts to avoid making arbitrary distinction between carinated scrapers, carinated burins, and bladelet cores, which can result in major tool class discrepancies that reflect the preferences of the individual archaeologist more than reality. To avoid this problem, all carinated pieces were taken out of the type list entirely, and examined according to a set of detailed attributes (Fig. 16.2). The motive for treating all carinated artefacts equally was to allow the identification of empirical groups and divisions, if any exist, both at the level of metric and morphological characteristics. Within the relevant literature (Breuil 1906:60; Bardon and Bouyssonie 1906:402; de Sonneville-Bordes and Perrot 1954:332; Brézillon 1971:235–236; Ferring 1976:216; Marks 1976b:246–255, 1976c:380–381; Bergman 1987a:12–13; Belfer-Cohen and Goring-Morris 1986:55; Demars and Laurent 1989:44, 52), these are the most frequently cited characteristics of carination: invasive, steep retouch with bladelet-dimension removal scars on a thick blank; a curved, or convex retouched edge; convergent retouch; and twisted removal scars. Although most researchers would agree that all of these are common characteristics of carinated implements, none of these characteristics by themselves must be present for an artefact to be considered carinated. The criteria used to identify carination in this study are the following, *all* of which must be present for an implement to be considered carinated: a curved profile of the retouched edge; three or more removals possessing bladelet dimensions; at least two twisted removals; and convergent to semi-convergent retouch (a natural result of twisted removals, and often resulting in a keel). While twisted removals are rarely used as a necessary attribute of carination, it is deemed important in this study to restrict carination to a specific reduction sequence, which sets it apart from all Upper Palaeolithic and Epipalaeolithic bladelet production (*e.g.*, the Ahmarian reduction sequence, which involves the production of primarily non-twisted bladelets)[1]. Using these criteria, carination includes both secondary blanks and cores/chunks, *apropos* previous discussion regarding whether to include carinated items amid the tools or the cores (Goring-Morris 1980a:45–46; Bergman 1987a:12). It is suggested here that all carinated implements, by their nature, are potentially tools and/or bladelet cores, and as a result it was regarded more beneficial to apply the same method of analysis to all carinated implements before further divisions. It should be noted that this methodology does not ignore important characteristics of carinated implements, such as whether the blank is a chunk/core or a flake/blade, as these and other attributes are recorded after the artefact is placed into the 'carinated' category.

More than half of the excavated material from each assemblage is housed at Southern Methodist University, where the author performed the analyses. Sampling procedures were tailored to the overall goals of the research and the idiosyncrasies of the sites. In an attempt to control for intra-assemblage patterning, horizontally random samples were taken from the large assemblages, such as Sde Divshon. When dealing with stratified assemblages at a single site, such as Ein Aqev, each level was sampled separately (Table 16.1).

Only complete artefacts were selected for detailed study. Because attribute relationships are focal aspects of the research design, the use of broken pieces would exclude examination of numerous attributes. Complete tools on a broken blank (*e.g.*, an endscraper on a distal segment of a blade) were tabulated only on the basis of type class and the characteristics of the broken blank (*i.e.*, proximal, distal, lateral).



	Arkov	D18	D27A	Ein Aqev	G11	K9A	Sde Divshon
Carination Index	58.43	12.9	31.63	44.44	42.15	35.11	1.03
Scrapers (%)	25.80	54.40	45.90	27.57	34.10	44.29	29.44
Burins (%)	31.60	14.40	25.10	31.31	20.31	22.86	19.80

Fig. 16.3. Carination Indices for sampled assemblages (carinated pieces/[burins + scrapers]).

Results

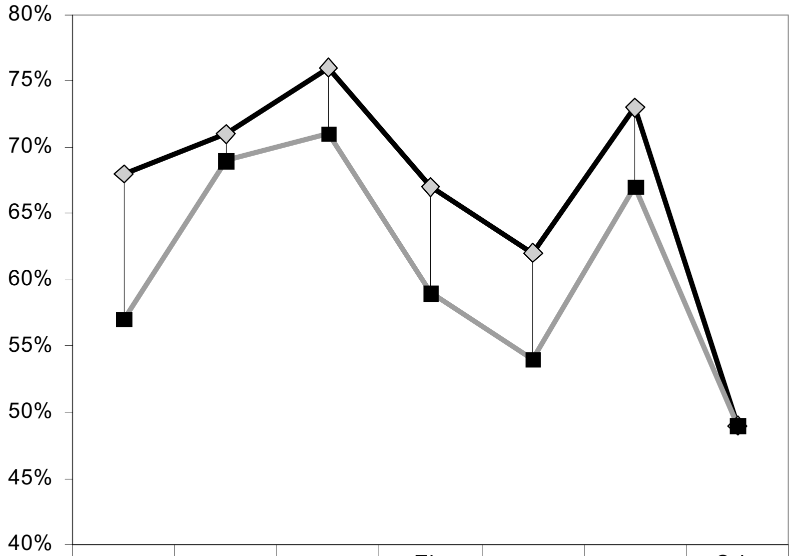
The flake technologies considered in this analysis can be divided into two broad groups, which have been identified as single and multiple reduction strategies by Ferring (1980), who performed a detailed technological analysis on many of the same assemblages. Put simply, multiple strategies involve at least two different sequences: one that produces a large component, and another that produces a small component. This is best seen at Ein Aqev, where the dichotomy between the large, retouched blades and tiny Dufour bladelets is strikingly apparent.

A single reduction strategy is observed only at Sde Divshon, which is characterized by initial large removals with complex scar patterns, then a continuous shift to almost exclusively single platform cores for interior blade removal, the products of which were often used as blanks for scrapers, or retouched into quite large el-Wad points.

A predominant carinated component is central to the reduction strategy of the remaining assemblages. An index was calculated by dividing the number of carinated pieces by the total number of burins and scrapers, as these are the two classes that merge into the carinated component in traditional type lists. Fig. 16.3 displays the carination index for the sampled assemblages, as well as the percentages of scrapers and burins in the toolkits, which was determined using the prescribed analytical procedure to separate and exclude all carinated pieces from the type list. Scrapers and burins have a largely inverse relationship among the assemblages, and the burin indices tend to correlate with the carination index. Sde Divshon has almost no carination index, while it is quite common in all of the other assemblages. Although this may seem contrary to earlier publications of Sde Divshon (Ferring 1976), the discrepancy is a result of the criteria used in this study to identify carinated artefacts, which differ from previous analyses. While D18 can be considered to have a carinated component, it is noticeably lower than within assemblages such as Arkov and Ein Aqev.

Even as the percentages of scrapers and burins dropped in most toolkits after excluding carinated pieces from the type list, especially at Arkov and G11, these tools remain predominant for all assemblages (Fig. 16.4). There were so few carinated pieces (as defined here) from Sde Divshon that the percentage of scrapers and burins did not change, representing just less than 50% of the total toolkit. To determine the percentage of burins and scrapers for the 'traditional typology' in Fig. 16.4, carinated pieces identified in this analysis were added to the combined totals of burins and scrapers (non-carinated varieties).

Any cursory look at a collection of carinated implements and Dufour bladelets allows one to see that the latter could have been produced from the former. The logical conclusion from such an observation – that carinated implements might have served as cores for bladelet production – has been recognized for some time,



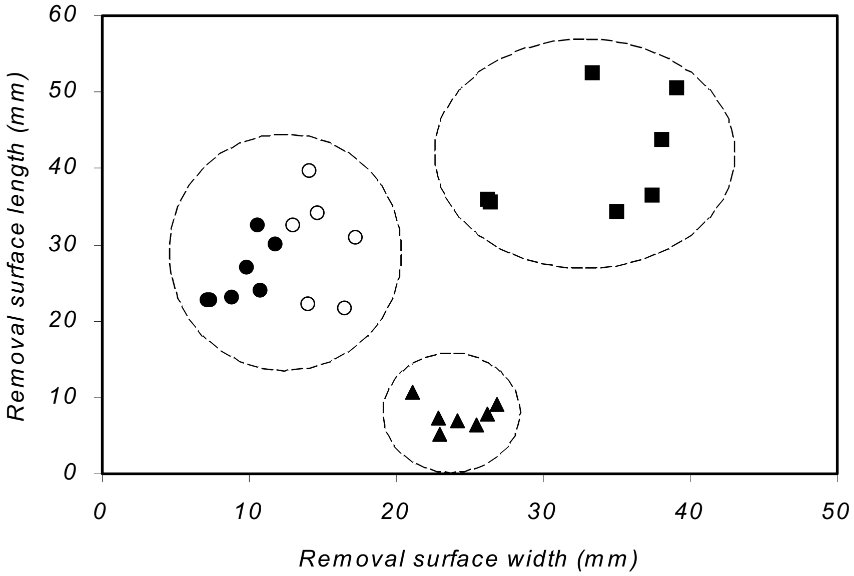
	Arkov	D18	D27A	Ein Aqev	G11	K9A	Sde Divshon
Scrapers & burins, traditional typology	68%	71%	76%	67%	62%	73%	49%
Scrapers & burins, excluding carinated	57%	69%	71%	59%	54%	67%	49%

Fig. 16.4. Scraper and burin percentages, before and after removing carinated pieces.

and has recently become a major issue in Aurignacian research (de Sonneville-Bordes 1963; Delporte 1968; Bordes 1968a; Tixier and Inizan 1981; Ferring 1980, 1988; Sala 1982; Bergman 1987a; Mellars and Tixier 1989; Rigaud 1993; Schmider and Perpère 1995; Lucas 1997; Almeida 2000:118–120). That carination is related to twisted bladelet production is becoming more apparent as this issue is further researched. Based on our current state of knowledge, therefore, it is more reasonable to view carination as a means of producing twisted bladelets, rather than as a means of shaping an edge for use as a burin or scraper.

Use-wear analysis, refitting, and experimental replication have yielded results which provide the most convincing arguments that carinated artefacts were used as cores for twisted bladelets and Dufour bladelets rather than as tools themselves (Sala 1982; Lucas 1997; Almeida 2000). The present analysis uses a different technique – metric measurements – to test the relationship between carinated artefacts, scrapers, burins, and cores. As defined in this analysis, cores are the remnants of blocks of raw material with the visible remains of removed spalls that could be included within any other class of artefact (flake, blade, bladelet, primary element, *etc*.), with the exception of twisted bladelet removals. By excluding artefacts with evidence of twisted bladelet removals, this definition of cores eliminates anything that would be identified as a 'carinated piece'. This separation was performed not to suggest that carinated artefacts were not cores, but to separate twisted removals as a reduction technique from other reduction strategies for comparative reasons. The most relevant metric properties of carinated pieces, scrapers, burins, and cores for their comparison are the size of the removal scars (*i.e*., the retouch for scrapers, the spalls for burins, the twisted bladelet removals for carinated pieces, and the spall removals for cores). The maximum width and length of the removal surface was measured for all of these artefacts. The mean removal surface width and length was determined for each artefact class (scraper, burin, carinated piece, and core), within each sampled assemblage. These data are displayed in Fig. 16.5, which demonstrates a clear pattern: carinated pieces are noticeably distinct metrically from scrapers and cores, but they cluster near the burins. Each plot represents the mean removal surface length and width for a single assemblage. The result is three distinct clusters: cores, scrapers, and carinated pieces together with burins.

Rather than suggesting that carinated pieces are burins, it is probable that many of these burins are initial stages of carinated implements. The dihedral burins, for example, in the sampled assemblages were produced with the same technique as the carinated artefacts, the major difference being that more spalls were removed on the carinated pieces, to the point where they started twisting around the blank. Other differences, at least between burins of dihedral varieties and carinated pieces, are minor, or are a natural result of the reductive process of carination, such as the regularization of the edge between the spall platform and



		Arkov n=149	D18 n=103	D27A n=330	Ein Aqev n=181	G11 n=257	K9A n=164	Sde Divshon n=147
▲ Scrapers	bit width	22.97	22.89	25.45	24.14	21.15	26.16	26.87
	bit thickness	5.22	7.22	6.49	7	10.77	7.89	9.06
■ Cores	removal surface width	26.42	35.04	38.03	39.03	26.17	37.38	33.3
	removal surface length	35.63	34.39	43.78	50.51	35.95	36.47	52.58
● Burins	removal surface width	7.17	10.54	7.3	9.81	10.75	8.79	11.77
	removal surface length	22.76	32.67	22.79	27.15	23.97	23.09	30.03
○ Carinated pieces	removal surface width	14.09	13.98	12.97	16.5	17.22	14.64	.
	removal surface length	39.79	22.22	32.64	21.77	31.06	34.12	.

Fig. 16.5. Mean dimensions of artefact classes from the various assemblages studied.

removal surface. Although the data presented in Fig. 16.5 do not account for the number of spalls removed, there is a direct correlation between removal surface width and the number of removed spalls, by nature of the definition of carinated artefacts used in this study (*i.e.*, twisted removals with bladelet dimensions). Additional evidence, namely overall size indices, also support the observation that many of the burins analyzed in this study are initial stages of carinated artefact production. Size indices were calculated by multiplying the length, width and thickness of an artefact, and dividing the result by 1000 (LxWxTh/1000). For all assemblages combined, the size index of burins was slightly larger than the carinated artefact size index (mean burin size index = 29.6 [n=441]; mean carinated artefact size index = 25.8 [n=240]). If some varieties of burins are indeed early stages of carinated artefact production, then this gross size difference is expected. This pattern is also manifest at the narrowed scale of each individual assemblage, with the exception of D18 (35.8 *vs*. 39.5 for the burin and carinated piece mean size indices, respectively), which might be explained by the extremely low sample size for carinated artefacts in this particular assemblage (n=8). D27A is the only other assemblage where the mean size index for burins is not larger than that for carinated artefacts, as they are nearly equal (26.2 and 26.3 for burins and carinated pieces, respectively [n=68]).

Although these lines of evidence suggest that carinated pieces served as twisted bladelet cores, the possibility remains that some carinated artefacts could have also been used as burins and/or scrapers. There is no reason why a twisted bladelet core, during its initial stage of manufacture, could not have been used as a burin, given the morphology of the platform and removal surface. Furthermore, it is also conceivable that as more bladelets were removed from a carinated piece, it could have been used as a scraper, if the angle of the platform and removal surface met the functional requirements of a scraping edge. In this sense, it is possible that a single technological sequence (*i.e.* carination) could have been used for two or more purposes. If this were true, then carination provides an efficient technique whereby both the core and the by-products (*i.e.* twisted bladelets) could have been used as tools during a continuous sequence of reduction.

The metric separation between cores and carinated pieces in Fig. 16.5 reflects multiple reduction strategies. Most of the cores are bulky and relatively amorphous, and were used to produce thick flakes, which served as secondary blanks for carinated pieces. Secondary blanks

were predominantly used for carinated pieces in nearly every sampled assemblage. The blank type for carinated pieces, as well as the method of carination (typical *vs*. lateral), allows the assemblages to be divided into two broad groups. Although lateral carination is the predominant method in the majority of the sampled assemblages, K9A and D18 are both dominated by typical carination. While this may seem trivial, typical and lateral carination involve two quite different sequences of reduction, which accounts for much of the variability in other aspects of the technology. Most of the carinated pieces at K9A and D18 were produced on core blanks, whereas the assemblages dominated by lateral carination used almost exclusively secondary blanks for carination. Therefore, instead of producing the bladelets through a separate reduction strategy involving secondary core blanks, the approach at K9A and D18 largely involved the sequential intensive reduction of larger cores into carinated pieces.

It should be stressed here that both assemblages, D18 and K9A, are limited in their potential for reconstructing past dynamics within the Upper Palaeolithic. D18 was found in a particularly deflated context atop the uppermost part of the north Divshon Ridge, spread along some 1,800 m² by low energy slopewash, indicating a strong potential for mixing. The taphonomy at D18, in addition to the low sample size (particularly for carinated artefacts), weakens any conclusions drawn from its lithic assemblage. K9A has recently come under scrutiny (Belfer-Cohen 1994), for its possible misidentification as an Upper Palaeolithic assemblage. The collection from K9 was originally divided into two separate assemblages (A and B), on the basis of differential raw material (flint and chalcedony) in what were thought to be two overlapping concentrations of artefacts – flint was assigned to the Upper Palaeolithic and chalcedony to the Epipalaeolithic 'Negev Kebaran' or 'Ramonian' (Larson and Marks 1977). Since this time, differential raw material usage has been observed at exclusively Epipalaeolithic assemblages from the Negev, which purportedly look similar to the K9 complex (Marder 1994; Belfer-Cohen *et al*. 1991; Belfer-Cohen 1994). Until detailed information is published from critical sites such as Nahal Neqarot (Belfer-Cohen *et al.* 1991), from which detailed comparisons with K9A and K9B could be made, the placement of K9A within the Upper Palaeolithic remains inconclusive.

Given that carination is a principal component within most of these lithic assemblages, it stands to reason that the by-products of carination (twisted bladelets and Dufour bladelets) should also be present in high numbers. This, however, is not the case for most of the assemblages in this study. Considering the number of carinated pieces that were produced, the near lack of twisted bladelets at most of these sites is peculiar and striking. The only site with significant numbers of twisted bladelets is Ein Aqev, which account for the unusually high blade-bladelet indices for this otherwise typical flake technology (blade/bladelet:flake ratio = 1.34:1 for debitage only, and 1.1:1 for debitage and tool blanks). Twisted bladelets should also be present at the other assemblages, since their negative impression is witnessed on the carinated pieces, but they are rare to absent. To demonstrate this phenomenon, a test was performed that attempts to gain some idea about the minimum number of twisted bladelets that could have been produced at each assemblage. Short of counting every bladelet scar on the carinated artefacts, the most reasonable method to determine this minimum number, with the data at hand, was to use an average width measurement for twisted bladelets in coordination with the removal surface width for all carinated pieces, in order to derive a rough estimate of the number of bladelets that were removed. Because there was a large sample of these twisted bladelets at Ein Aqev, they were used to calculate the average twisted bladelet dimensions (Fig. 16.6). This test does not claim that the width of twisted bladelets at Ein Aqev is necessarily representative of those from the other assemblages, or that the derived numbers should be accepted as anything close to exact figures. The calculations here were produced only to give a rough estimation of the minimum number of twisted bladelets that should have been produced, given the number of carinated artefacts recovered. It is extremely improbable that any of these estimates could be larger than the actual figures, because only the width of the removal surface is accounted for, and not the curvature, or the bladelets that were removed before the ones that left negative impressions.

Of 114 twisted bladelets and Dufour bladelets at Ein Aqev, the average width was 5.6 mm. For each assemblage, the total removal surface width was calculated for carinated pieces, and then divided by 5.6. If this number remained positive after subtracting the number of existing twisted bladelets, then an approximation of missing bladelets was provided.

Most assemblages had large percentages of missing bladelets (Fig. 16.7). Blades were included to show how the minimal estimate of bladelets produced from carinated artefacts might affect the overall blade-flake dichotomy. These percentages reflect both debitage and tool blanks, since the bladelets produced from carinated pieces would potentially be found as both debitage and tools. Except for Ein Aqev, where the twisted bladelets were present, and Sde Divshon, where there is very little carination, the missing bladelets provide quite a boost to the blade/bladelet indices for the remaining sites. Notably, both Arkov and D27A become dominated by blades and bladelets when this minimal estimate is applied. Such a boost to the blade-bladelet indices is important to consider, because the percentage of blades *versus* flakes is one of the major defining criteria for the different Upper Palaeolithic traditions.

Two possibilities might explain why these bladelets are missing: they were carried away by the people who made them, or they were naturally washed away. Taph-

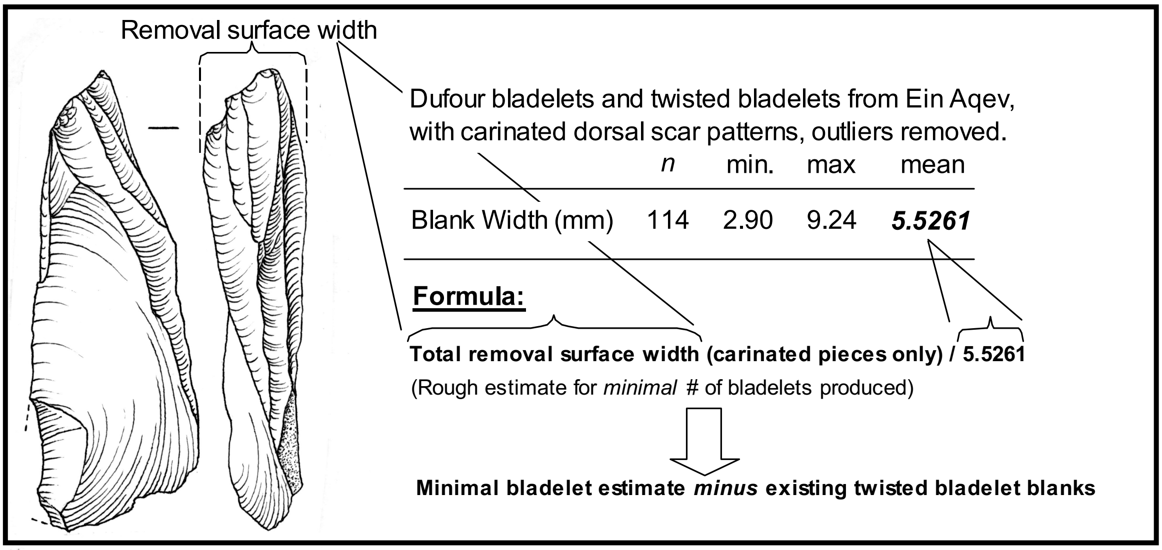
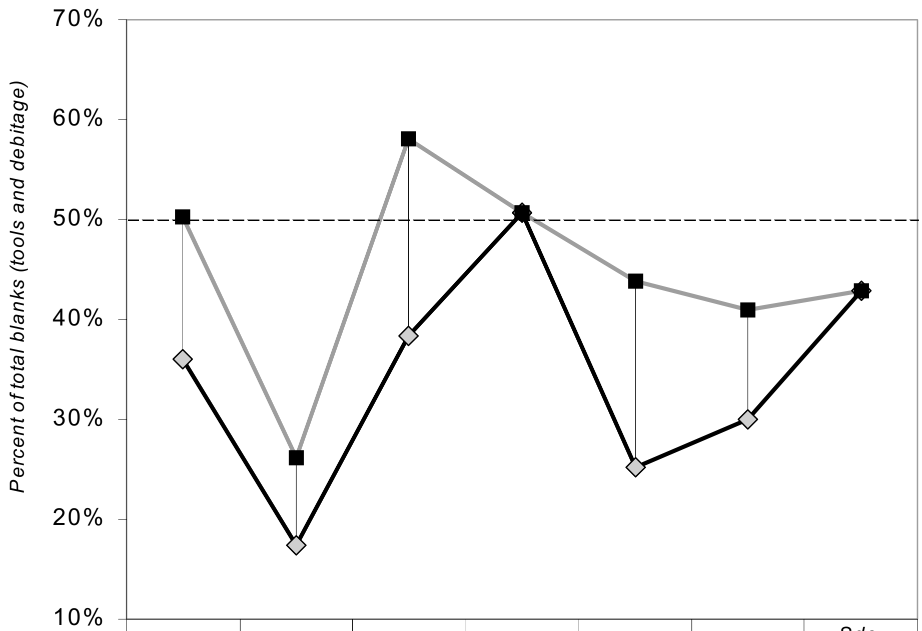


Fig. 16.6. Process of calculating the minimum number of missing bladelets for each assemblage.



	Arkov	D18	D27A	Ein Aqev	G11	K9A	Sde Divshon
Blades & bladelets, % restricted	36.07%	17.36%	38.32%	50.68%	25.23%	29.94%	42.86%
Blades & bladelets, % restricted, including estimated frequency of twisted bladelets	50.23%	26.22%	58.05%	50.68%	43.86%	41.02%	42.86%

Fig. 16.7. Blade-bladelet indices, before and after calculating estimates for missing twisted bladelets.

onomy is a viable explanation for bladelet absence because all of the sites with missing bladelets were found deflating from aeolian deposits. It is also quite possible that the bladelets left the sites with the people who made them. A relevant example of this is a recent study by Almeida (2000) of Lapa do Anecrial, a Terminal Gravettian assemblage in Portugal. Ninety-two percent of the weight of this highly carinated lithic assemblage

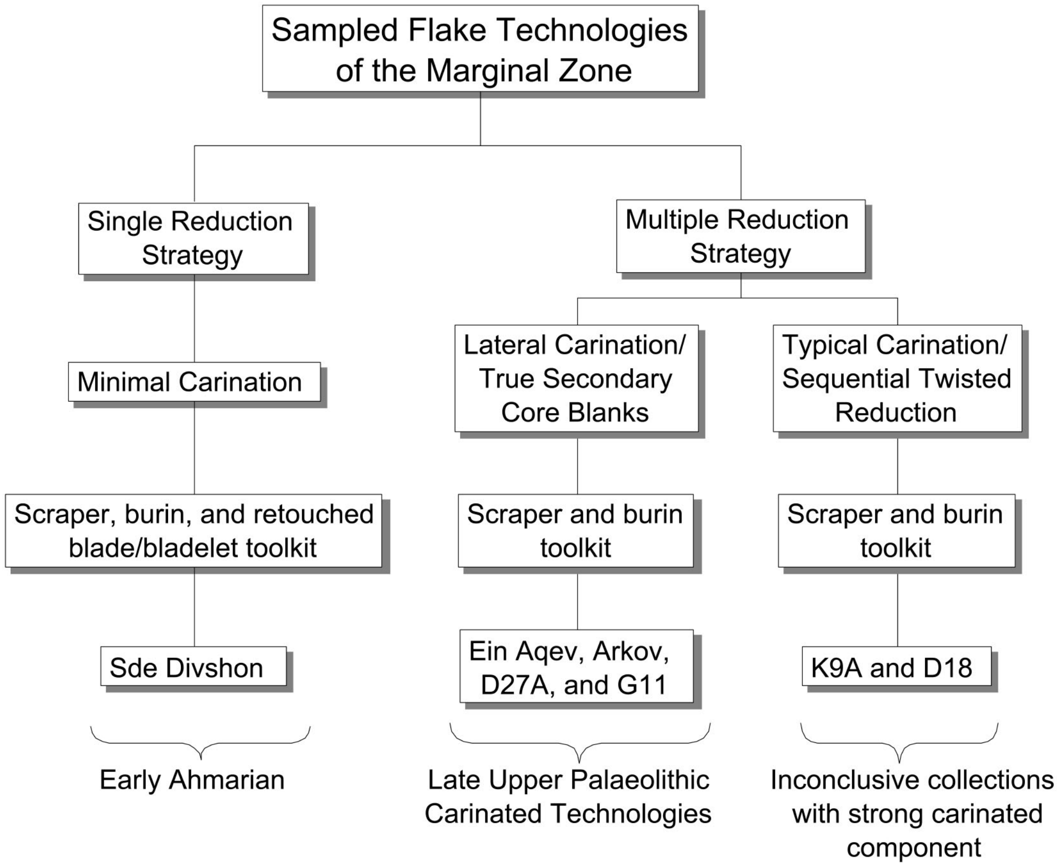


Fig. 16.8. Basic division of sampled assemblages.

was refitted, revealing that 50% of the twisted bladelets were missing from carinated reductions. The Gravettian artefacts from this collapsed cave were preserved in their original spatial patterning after the occupation, which allows the conclusion that the twisted bladelets were removed by their makers. It is also noteworthy that a use-wear study of this assemblage found no signs of wear on the carinated pieces, unlike the scraping wear observed on flat, uncarinated scrapers (Almeida 2000:164–166).

Regardless of how they were removed, these missing bladelets bring the remaining carinated assemblages into the same range of blade-bladelet percentages as Ein Aqev, making them similar in that respect.

On the basis of these preliminary results, the assemblages fall into three groups (Fig. 16.8). As Ferring (1980) observed in studying some of the same assemblages, Sde Divshon most closely resembles the single reduction strategy of the Early Ahmarian, bearing a high degree of affinity with Boker BE, level III, which has a series of radiocarbon dates averaging 27,000 bp (Marks 1983b). Those using multiple reduction strategies form another group, characterized by a technology dominated by carination. A further division of these assemblages into two groups can be made on the basis of their carinated technique. Given that Ein Aqev is the only dated assemblage, at around 17,500 bp (Marks 1977b:7), the lateral carinated assemblages can be tentatively placed within the Late Upper Palaeolithic. Placing K9A and D18 into a time frame becomes more problematic, for the reasons discussed above.

Discussion and Conclusions

How do these carinated technologies with multiple reduction strategies fit into the broader Levantine Upper Palaeolithic? If we expand the scale only to the marginal zone, then the assemblages used in this study show a pattern of land use distinct from that of the Ahmarian (Early and Late). A study by Gladfelter (1997) revealed that Ahmarian assemblages tend to be situated in montane areas, such as the central Negev Highlands, the mountains running from central-western to southern Jordan, and southern Sinai. Within these montane settings, however, the blade-dominated Ahmarian assemblages are situated at lower elevations (*e.g.*, at the bottom of wadis), adjacent to the highest areas, and specifically near permanent water sources (Williams 2000). In contrast, the sites used in this study are nearly all situated at higher elevations, more distant from permanent water sources. With the exception of Ain Aqev, they are all located over one kilometre from

Table 16.3. Environmental, technological, and typological variables for Levantine Upper Palaeolithic assemblages.

Assemblage	Label	masl	Distance to nearest spring (km)	Flakes, % restricted	Blades & bladelets, % restricted	Blade-flake ratio	Reference
Ein Qadis IV	Ahmarian/ Lagaman	625	.00	38.40%	61.64%	1.61	Goring-Morris 1995a
Lagama III A	Ahmarian/ Lagaman	250	.24	47.71%	52.29%	1.10	Gisis & Gilead 1977
Lagama III C	Ahmarian/ Lagaman	245	.40	50.79%	49.21%	.97	Gisis & Gilead 1977
Lagama III D	Ahmarian/ Lagaman	244	.20	48.73%	51.27%	1.05	Gisis & Gilead 1977
Lagama III E	Ahmarian/ Lagaman	250	.30	45.24%	54.76%	1.21	Gisis & Gilead 1977
Lagama III G	Ahmarian/ Lagaman	245	.30	47.46%	52.54%	1.11	Gisis & Gilead 1977
Lagama V	Ahmarian/ Lagaman	300	.50	34.94%	65.06%	1.86	Bar-Yosef & Belfer 1977
Lagama VI	Ahmarian/ Lagaman	312	.50	23.89%	76.11%	3.19	Bar-Yosef & Belfer 1977
Lagama VII	Ahmarian/ Lagaman	310	.40	20.70%	79.30%	3.83	Bar-Yosef & Belfer 1977
Lagama VIII	Ahmarian/ Lagaman	309	.10	39.07%	60.93%	1.56	Bar-Yosef & Belfer 1977
Lagama XI	Ahmarian/ Lagaman	298	.20	48.50%	51.50%	1.06	Bar-Yosef & Belfer 1977
Lagama XII	Ahmarian/ Lagaman	310	.20	44.26%	55.74%	1.26	Bar-Yosef & Belfer 1977
Lagama XV	Ahmarian/ Lagaman	322	.70	34.34%	65.66%	1.91	Bar-Yosef & Belfer 1977
Wadi Sudr 6	Ahmarian/ Lagaman	300	.50	33.10%	66.90%	2.02	Baruch & Bar-Yosef 1986
Jebel Humeima II & III	Ahmarian/ Lagaman	960	.50	48.72%	51.28%	1.05	Kerry 1997a
Tor Aeid, 0-60 cm	Ahmarian/ Lagaman	975	.40	41.30%	58.70%	1.42	Williams 1997a
Tor Hamar F-G	Ahmarian/ Lagaman	1012	.25	33.33%	66.67%	2.00	Coinman & Henry 1995
Ein Aqev East	Late Ahmarian	404	.00	35.47%	64.53%	1.82	Ferring 1977
K9A	Sampled Assemblage	980	5.00	66.18%	33.82%	.51	this study
Arkov A	Sampled Assemblage	500	2.00	61.55%	38.45%	.62	this study
D18	Sampled Assemblage	525	2.10	37.33%	21.42%	.13	this study
D27a	Sampled Assemblage	505	1.50	74.17%	25.83%	.35	this study
Ein Aqev	Sampled Assemblage	390	.00	42.77%	57.23%	1.34	this study
G11	Sampled Assemblage	980	4.70	74.53%	25.47%	.34	this study
Sde Divshon	Sampled Assemblage	505	1.50	62.10%	37.90%	.61	this study

a spring (Williams 2000; see Table 16.3). Fig. 16.9 shows that, within the marginal zone, as the distance of a site from a spring increases, its blade-flake ratio decreases. In other words, occupations with predominant blade-bladelet technologies tend to be positioned near a spring. The plots in Fig. 16.9 (and the 'distance to nearest spring' column in Table 16.3) are restricted to assemblages where the primary water source during the time of occupation was a spring, rather than a lake or marsh, according to palaeoenvironmental evidence. It is interesting to note that while Ein Aqev is situated near a spring and has a blade-bladelet dominated technology, the remaining carinated assemblages used in this study are all situated on plateaus, away from springs, with flake-dominated technologies. This environmental and technological trend undoubtedly relates to the missing bladelet issue discussed earlier, but whether it is caused by curation or taphonomy remains to be determined. Various lines of evidence suggest that perhaps we are seeing a real human response to resource distribution, rather than post-occupational disturbance. As mentioned earlier, the curation of twisted bladelets has been documented in a prehistoric context through refitting (Almeida 2000). Also, there are numerous cases of Epipalaeolithic sites situated high in the Har Harif, deflating from aeolian deposits, with toolkits dominated by microliths (Marks and Simmons 1977:Table 10–10). Finally, the technology and typology at Sde Divshon, while unaffected by the missing bladelet issue of the carinated technologies, nevertheless displays unusual indices within an otherwise typical Early Ahmarian reduction sequence. The nature of these indices appears to reflect activities that took place at the site, rather than post-occupational disturbance. Despite its undeniable Ahmarian flavour, flakes dominate the technology at Sde Divshon, and scrapers and burins are the most frequent tools. Perhaps these atypical artefact indices relate to a site locality high on the Divshon Plain, in contrast to the wadi floor, where the typical Ahmarian sites are located. Judging from its size and artefact density, Sde Divshon was probably a basecamp, where a different set of activities was carried out than those of the hunting camps located near permanent water sources (*e.g.*, Boker A). In this respect, the carinated technologies with impoverished bladelet indices on the high plateaus may represent part of a broader subsistence strategy that encompasses the bladelet-rich Ein Aqev. The presence of numerous Dufour bladelets at Ein Aqev might be explained by the occurrence of activities that were tethered to a permanent water source.

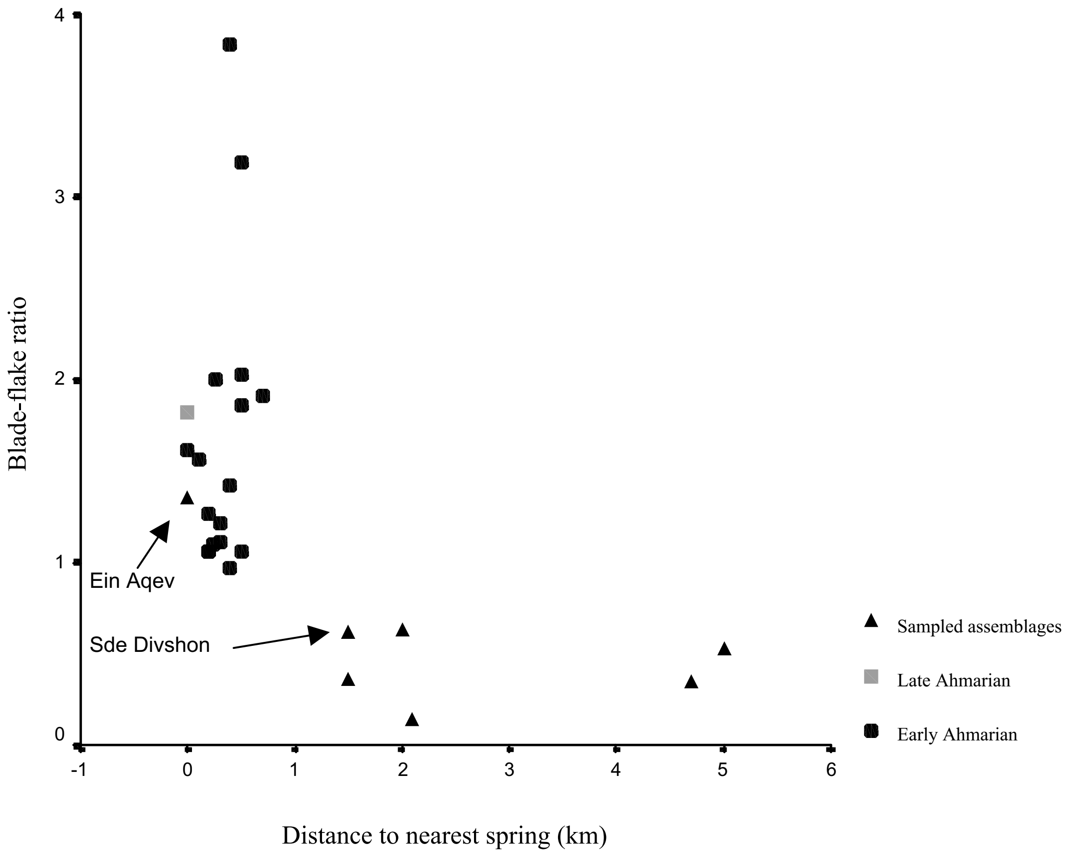


Fig. 16.9. The relationship between technology and distance from springs, restricted to assemblages in the marginal zone, and those where the primary water source during the time of occupation was a spring.

Borrowing a term from Coinman and Henry (1995: 194), the presence of a 'Non-Ahmarian' entity in the Negev is undeniable. Giving a more specific name to this entity, however, is more controversial. Coinman and Henry (*ibid.*) originally subsumed the 'Non-Ahmarian' assemblages in southern Jordan under the title of 'Levantine Aurignacian', although admitting it was an uncomfortable fit. Some of these assemblages (J412 and J432) have since been relabelled, as the title 'Levantine Aurignacian' was deemed inappropriate (Coinman and Henry 1995; Kerry 1997a). A similar dilemma was addressed earlier by Belfer-Cohen and Goring-Morris (1986:55–56), who decided that neither of the categories available in the two-tradition framework was appropriate for the Har Horesha I assemblage of the Har Harif plateau. Suffice it to say that the two-tradition framework becomes more problematic when crossing the boundary between the arid marginal and Mediterranean core zones. This is not surprising, since it was originally used to describe assemblages that were discovered in a small area of the central Negev, albeit using terminology ('Levantine Aurignacian') from the northern Levant (Marks 1976d: 68). It has always been known, therefore, that variability within these traditions increases as the geographic scale is broadened (Marks 1977b:20). As noted by others (Bergman 1987a:143), it is possible that this variability may warrant another, distinct facies in the northern Levant as well.

The multiple reduction strategies analyzed in this study do posses some of the attributes traditionally considered to be Levantine Aurignacian (*e.g.*, carination, nosed and shouldered scrapers, multifaceted burins), while some attributes are extremely rare or altogether missing (Aurignacian retouch, bone and antler tools, and art). There is no denying a Levantine Aurignacian presence in the central-northern Levant, since this is where it was first identified and defined. The next logical step, therefore, is to expand an analysis similar to that presented above to the classic cave and rockshelter sites. While significant strides have been made in this direction (*e.g.*, Belfer-Cohen and Bar-Yosef 1981, 1999; Bar-Yosef and Belfer-Cohen 1988; 1996; Belfer-Cohen 1994), a comparison of the available data, beyond the most basic level, is difficult because of differences in the way data were tabulated and published.

Currently, a large-scale comparison of assemblages that have been considered to be Levantine Aurignacian, between the Mediterranean core and marginal areas, must

deal with an apples-oranges obstacle. Clearly it would be useful to conduct an inter-regional study, holding the method of analysis constant, to see if relevant analytic units fall within the same ranges, and what factors might condition any perceived differences.

Acknowledgments

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Notes

1 Bladelets have a maximum length of less than 50 mm and a maximum width of less than 12 mm (after Tixier 1963:38), which is an arbitrary cut-off, but is considered useful in this study because it restricts the dimensions to within the range of Dufour bladelets, a by-product of carination.

17. Cultural Variability in the Late Upper Palaeolithic of the Levant

Daniel Kaufman

Introduction

Since the 1980s, the most widely held explanation for inter-assemblage variability within the Levantine Upper Palaeolithic is of two time-transgressive and partially contemporaneous entities, the Ahmarian and the Levantine Aurignacian (Gilead 1981a; Marks 1981a). Generally referred to as lithic traditions, they are distinguished on the basis of their techno-typological characteristics. The Ahmarian is characterized by a very standardized blade-bladelet technology and elongated blanks were the preferred form for tool manufacture. Typologically, these assemblages contain numerous pointed items, usually variants of el-Wad points, backed and retouched blades and bladelets, endscrapers and simple burins. The Aurignacian, on the other hand, lacks a standardized blade technology and flakes outnumber blades both with regard to overall debitage counts and blanks selected for tool manufacture. Levantine Aurignacian toolkits are characterized by relatively high frequencies of endscrapers, often thick and/or carinated, and burins. It is recognized here that there is considerable variability within each of these groups but it is not the purpose of the paper to enter into this issue or the taxonomic problems associated with it. We follow here the suggestion of Belfer-Cohen (1994) and refer to each as a macro-tradition and retain the terms Ahmarian and Levantine Aurignacian as a matter of convenience.

The fact that we are dealing with two distinct traditions, at least in terms of technological and typological characteristics, raises the question as to whether it is possible to discern variability in other aspects of cultural behaviour that is also particular to each group. Earlier studies (Kaufman 1981, 1987, 1988) on a small sample of five sites indicated that this was the case. The question will be further examined with a larger sample by considering two aspects of a number of lithic assemblages attributed to the final stages of the Levantine Upper Palaeolithic. The first relates to toolkit configuration as expressed through assemblage diversity and the second concerns raw material exploitation as seen in debitage to tool ratios and debitage to core ratios. As will be shown, there are differences in these that indicate varying cultural behaviours and adaptations specific to each of the traditions particularly with regard to settlement patterns, mobility and curation.

The Sites

The data to be presented here are taken from nine sites attributed to the final stages of the Levantine Upper Palaeolithic and dating from between *ca.* 22–18,000 bp. This chronological assignment is based on radiocarbon determinations, stratigraphic/geomorphological relationships and techno-typological considerations (Byrd 1988, 1994; Coinman 1993b, 1997a, 1998b; Edwards *et al.* 1988; Garrard *et al.* 1985, 1986, 1994; Goring-Morris 1987, 1995b; Goring-Morris and Belfer-Cohen 1997; Housley 1994). The rationale for this relatively restricted temporal range lies in the fact that both of the traditions have considerable time depth and it was felt that aggregating a large number of sites as if they represented a single slice of time would mask potential chronological shifts.

Five of the assemblages, consisting of blade/bladelet industries, are attributed to the Ahmarian. These include the following sites:

1 Ein Aqev East, located in the central Negev Highlands (Ferring 1977; Kaufman 1981);
2 Fazael X, in the lower Jordan Valley (Goring-Morris 1980a, b);
3 Ohalo II, a submerged site on the eastern shore of the Sea of Galilee (Nadel 1991, 1997a);
4 Shunera XVI, in the western Negev dunes (Goring-Morris 1987);
5 Ain el-Buhira, in the Wadi al-Hasa, Jordan (Coinman 1993b).

The remaining four, characterized by a flake technology, assigned to the Levantine Aurignacian include:

1 Ein Aqev, in the central Negev Highlands (Marks 1976b; Kaufman 1981);

2 Boker Area C (D100C), in the central Negev Highlands (Jones *et al.* 1983);
3 Fazael IX (Goring-Morris 1980a, b), in the lower Jordan Valley;
4 Nahal Ein Gev I, situated in the northern Jordan Valley on the eastern shore of the Sea of Galilee (Bar-Yosef 1973).

Comparisons

As noted above, the assemblages will be compared on the basis of two characteristics, toolkit configurations and raw material exploitation. The first of these relates to toolkit diversity in that it provides information concerning settlement patterns. The rationale is that comparisons of toolkit configurations allow for defining occupation types within a settlement system. Prehistoric settlement patterns reflect the ways in which human beings distributed their activities differentially in space so that any given site represents but a single example of one settlement type within the general settlement network. The problem exists that any given locality may have seen multiple occupations of varying types so that collapsing assemblages masks this potential variability. However, in an earlier study (Kaufman 1981), comparisons between stratigraphic units of several attributes (quantitative and qualitative) at the sites of Ein Aqev East, Ein Aqev, Fazael X and Fazael IX showed no significant differences. The indication is that even if multiple occupations did occur, they were all functionally similar. It is assumed here that the same can be said of the other sites in this study.

The problem '… is to identify…and thereby define one or more settlement types which together comprise the total settlement system' (Streuver 1971:11). The objective in describing toolkit configurations is to derive information concerning site function, specifically the range of activities that may have been conducted at each, and developing an occupation typology and models of settlement patterns. On the assumption that tools with similar working edges were used in a like manner, tool classes such as scrapers, burins, *etc*., can be considered as functional sub-units of the total tool assemblage (Henry 1973). Therefore, the makeup of a toolkit is determined by functional, activity-specific requirements. This has been demonstrated for the Middle Palaeolithic of the Negev (Marks and Friedel 1977) and, on an intra-site level, at Level 1 of Boker Tachtit, where activity specific areas were defined on the basis of their typological configurations (Hietala 1983b).

Table 17.1 shows the relative frequencies of tool classes for each of the sites under consideration. It is clear from this table that not all classes are represented in each of the sites and that one of the sites, Fazael IX, is heavily dominated by one tool class, the burins. In other words, there is apparently variability between what is generally referred to as richness, the number of tool classes in an assemblage, and evenness or the distribution of classes within an assemblage.

In order to examine this variability in detail, values for both richness and evenness were calculated (Kaufman 1998). Richness was measured by Margalef's diversity index D_{Mg} (Magurran 1988) through the formula:

$$D_{Mg} = (S\text{-}1)/InN$$

where S is the number of tool classes and N is the sample size. A measure of evenness was based on the reciprocal of the coefficient of variation (the standard deviation of the frequencies of the classes in each sample divided by the mean of the sample) as studies have shown that measures relating to variance can be used to describe evenness (Fager 1972; May 1981; Whittaker 1972). The values for each of these measures were derived through a technique known as jack-knifing. As outlined in Kaufman (1998, and references therein), this technique provides unbiased estimates of any given statistic and also minimizes the effects of varying sample sizes. Since evenness is a function of the variance, less evenly distributed assemblages have high values for this index; low values indicate more even distributions. High values for richness indicate presence of a greater number of tool classes.

For the second characteristic, degrees of raw material exploitation were estimated through debitage to tool ratios and blank to core ratios. The first of these was calculated by dividing the number of unretouched blanks (blades, bladelets, flakes, primary elements and core trimming elements) by the number of retouched tools while the second is the total number of blanks (retouched and unretouched) divided by the number of cores. Assemblages with relatively low frequencies of debitage in relation to retouched tools may indicate a more efficient use of raw materials available on-site in that more of the available blanks were further processed into formal tools. Low ratios of blanks in relation to cores are indicative of on-site processing of nodules while high values for this index suggest the importation of prepared blanks to habitation sites.

Table 17.2 shows the jack-knifed values for richness and evenness for each of the sites. When these two variables are plotted against each other, as in Fig. 17.1, it can be seen that the two Aurignacian sites of Ein Aqev and Nahal Ein Gev I cluster together. These two sites exhibit the greatest overall assemblage diversity in that they are the richest and have the highest levels of evenness. The other two Aurignacian sites are outliers on the scattergram. Boker C, with only four tool classes, has the lowest measure of richness. It is true that this site has a very small sample. However, the jack-knife technique helps to offset this problem and, it addition, this was apparently a small occupation originally (Jones *et al.* 1983). A small, very ephemeral site would not be likely to yield a large sample. Fazael IX, on the other hand, has the least even distribution of tool classes because of the heavy dominance of burins in the toolkit.

The Ahmarian sites form a very loose cluster in the centre of the graph. Four of them in particular, Ohalo II,

Table 17.1 Percentages of tool classes for late Upper Palaeolithic sites.

	Levantine Aurignacian				Ahmarian				
	Ein Aqev N=277	Nahal Ein Gev I N=195	Fazael IX N=626	Boker C N=32	Ain el-Buhira N=870	Shunera XVI N=230	Ohalo II N=731	Ein Aqev East N=602	Fazael X N=1625
Scrapers	23.82	12.82	2.07	31.25	9.65	6.95	0.82	19.77	12.31
Burins	15.52	29.74	66.61	12.5	4.25	3.04	3.69	7.64	10.15
Perforators	2.16	1.54	0.0	0	0.46	4.78	1.92	0.16	0.31
Backed Pieces	3.25	2.05	2.23	0	0.46	0	0	0.33	0.25
Truncations	2.89	5.64	3.83	0	3.33	6.95	1.23	3.65	1.41
Notch/Denticulates	11.91	23.07	7.03	12.5	0.80	3.04	4.37	12.46	5.91
Retouched Pieces	14.08	5.13	5.91	31.25	14.94	4.78	16.42	6.97	4.55
Multiple Tools	2.16	1.54	1.28	0	0.69	0	1.23	0.66	0.80
Microliths	18.41	10.77	7.19	0	62.53	56.52	68.95	44.68	62.34
Special Tools	4.69	6.15	1.91	0	1.49	9.56	0	2.32	0.80
Varia	1.08	1.54	1.91	12.5	1.38	4.78	1.36	1.33	1.17

Table 17.2 Values for richness and evenness (jack-knifed), debitage:tool ratios and blank:core ratios for Upper Palaeolithic sites.

	Richness	Evenness	Debitage:Tool	Blank:Core
Ein Aqev	3.27	0.87	7.36	38.91
Ein Aqev East	2.87	1.69	11.81	26.53
Nahal Ein Gev I	3.45	1.06	4.75	55.10
Fazael IX	1.91	3.47	2.17	75.34
Fazael X	2.42	2.46	11.45	78.67
Ain el-Buhira	2.68	2.85	11.62	71.71
Shunera XVI	2.32	2.42	17.50	114.02
Ohalo II	2.07	2.43	21.98	493.2
Boker C	2.06	0.51	5.68	34.6

Shunera XVI, Fazael X and Ain el-Buhira all show moderate levels of evenness while they vary slightly along the richness axis. Within the group of Ahmarian sites, Ein Aqev East is a moderate outlier as its overall diversity is slightly greater than that of the others.

The values for debitage to tool and blank to core ratios are also presented in Table 17.2. For the debitage to tool ratios (Fig. 17.2), it is clear that in all cases, the Ahmarian assemblages, occupying the upper portion of the plot, have much higher ratios than do the Aurignacian sites. The blank to core ratios (Fig. 17.3; Ohalo II does not appear because its very high value skews the scale of the graph) do not show a similar pattern. Rather than grouping on the basis of tradition, they separate out on a geographic basis with the sites found in the Negev Highlands having lower ratios than do sites in other regions.

Discussion

On the basis of the comparisons of toolkit diversity, it is clear that different kinds of occupations have been isolated. This is best seen when comparing the sites attributed to the Aurignacian. Looking first at Nahal Ein Gev I and Fazael IX, these two sites share techno-typological attributes. In addition, common to both is a stylistic element seen in the very standardized burins on truncation that occur in both of these sites which strongly indicates that they belong to the same cultural entity (Kaufman 1981). Nahal Ein Gev I, with its high richness value and even distribution of tool classes, is a multipurpose camp while Fazael IX, with its reduced richness and evenness resulting from the dominance of burins, represents a specialized activity station. This indicates a pattern of hunter-gatherers organized in a logistical system of

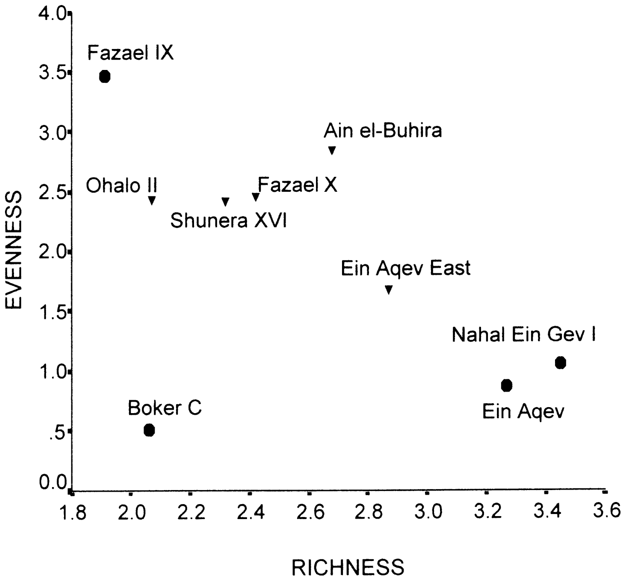

Fig. 17.1 Scattergram of jack-knifed values of richness and evenness for Late Upper Palaeolithic sites. Circles = Aurignacian; Triangles = Ahmarian.

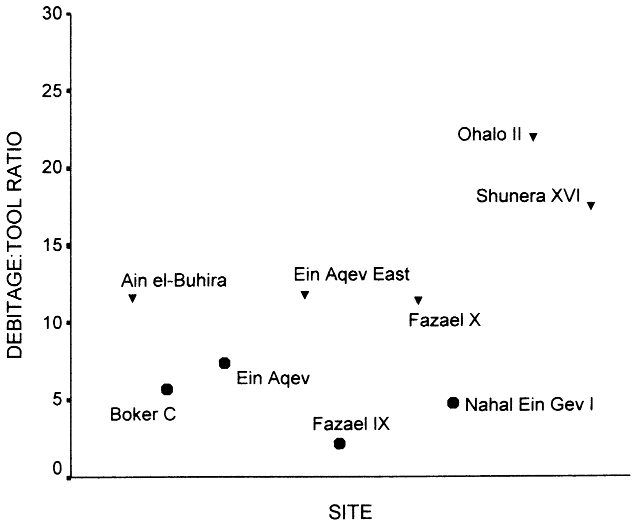

Fig. 17.2 Debitage to tool ratios for Late Upper Palaeolithic sites. Circles = Aurignacian; Triangles = Ahmarian.

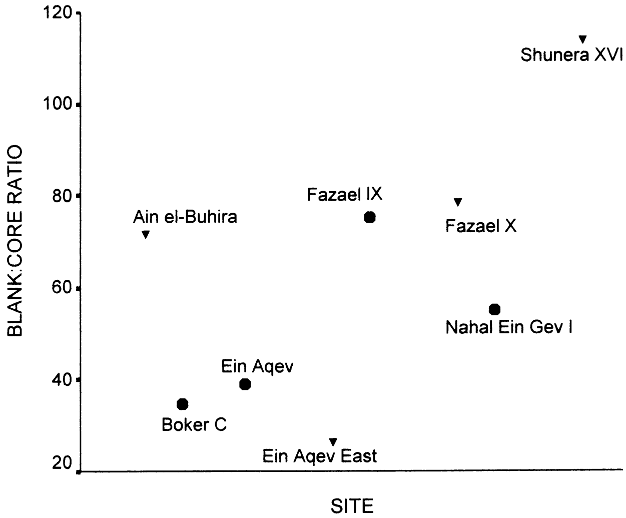

Fig. 17.3 Blank to core ratios for Late Upper Palaeolithic sites. Circles = Aurignacian; Triangles = Ahmarian.

mobility (Binford 1980). It cannot be stated with certainty that the two sites belong to a single given settlement system, especially when considering the distance between them (*ca*. 75 km). At the very least they do represent examples of different components within a model settlement system. It can be hypothesized that in the vicinity of Nahal Ein Gev I, satellite camps similar in character to Fazael IX would be found. For the lower Jordan Valley, Fazael IX should be associated with a site similar to the base camp of Nahal Ein Gev I.

A very similar pattern can be observed for the Aurignacian sites of the central Negev Highlands. Ein Aqev, not unlike Nahal Ein Gev I in terms of both richness and evenness, also most likely represents a base camp within a logistical system. This site can be linked culturally to Boker C on the basis of the latter's stratigraphic position and techno-typological similarities (A.E. Marks personal communication) and, like Fazael IX, represents a secondary camp within a logistically organized system. In this case, however, a very limited range of activities was carried out as opposed to the concentration on a single, specific activity at Fazael IX.

The Ahmarian sites are admittedly somewhat more difficult to interpret because there seems to be a greater range of variability within the group. It is noteworthy that none of them falls within a category of specialized activity camp. The moderate evenness values for these sites indicate that no specific activity or limited range of activities took place at them. The lack of specialized activity sites would indicate that the Ahmarian is characterized by hunter-gatherers operating in a residentially mobile organized system (Binford 1980). In such a system, levels of mobility would be considerably higher and occupations more ephemeral than in a logistical system. The variability between the sites in the group may stem from factors that are difficult for the archaeologist to observe such as the duration of occupation, the number of repeat visits at the same location (even though, as noted above, all re-occupations were functionally similar) and post-depositional processes. There seems no

doubt, however, that the pattern seen for the Ahmarian is very different from that proposed for the Aurignacian.

Turning to the debitage to tool ratios, the Ahmarian sites have considerably higher debitage to tool ratios than those of the Aurignacian. This means that the latter sites are characterized by a much higher rate of utilization of the available blanks with more of them being modified into tools. Such economizing behaviour can be explained by differing forms of curation and what I refer to as on-site as opposed to off-site production of blanks. The proposition is that for the Aurignacian there was a stronger tendency toward primary blank production on or, very near to, raw material exposures, with curation of blanks and prepared cores at the habitation site. Such behaviour would, in turn, require a greater rate of exploitation of those materials brought to the site. This conforms well with the notion of a logistical adaptation for the Aurignacian in which habitation sites were equipped from secondary workshops.

There are two interrelated factors that resulted in the higher debitage to tool ratios in the Ahmarian. The first incorporates the notion of a stronger trend toward on-site production of blanks. The core assemblages from these sites are always dominated by small bladelet cores, and it is possible that prepared cores (or even small nodules) were carried into the sites. With blanks being produced on-site, there is less need to economize which results in lower rates of utilization in these assemblages. In addition, recalling that the Ahmarian is characterized by a more highly mobile settlement system, the ratios also may indicate the curation of blanks. It is important to stress here that these assemblages are heavily dominated by bladelets and microlithic tools, all of which are easily transported. The curation of bladelets produced through a very prolific bladelet technology, together with the curation of small, prepared cores or nodules, would guarantee that suitable blanks for tool manufacture would always be available.

As noted above, the blank to core ratios show a geographic patterning which cross-cuts the lithic traditions with the Negev Highland assemblages having fewer blanks per core than those from other regions. Relatively speaking, the two Aurignacian sites in the Negev Highlands (Boker C and Ein Aqev) have slightly higher ratios than does the Ahmarian site in that region (Ein Aqev East). The interpretation is that the two Aurignacian sites depended to a greater degree on supplies (prepared blanks) brought in from workshops, while somewhat more intensive reduction of nodules was carried out at the Ahmarian site of Ein Aqev East.

Outside of the Negev Highlands, all of the Ahmarian assemblages, including the lowland dune site of Shunera XVI, show a high number of blanks per core, indicating, as above, a dependency on the curation of blanks, especially bladelets. A similar pattern is observed for the Aurignacian assemblage of Fazael IX, which is expected, given the very special nature of this site. In this case, however, it was primarily flakes for the production of burins that were carried in and were either produced at a workshop or brought from a habitation site. It is worth noting that the base camp of Nahal Ein Gev I has the lowest blank to core ratio meaning that, as expected at such a habitation site, some on-site processing was taking place in addition to bringing in materials from workshops.

While there are clear differences between the two traditions with regard to both toolkit diversity and raw material exploitation, there is the possibility that geographic setting also played a role in this variability. Further support for the influence of geographic factors was found through an analysis of the metric attributes of the debitage (Kaufman 1987). As these data were available only from Ein Aqev, Ein Aqev East, Nahal Ein Gev I, Fazael IX and Fazael X, the comparisons will be limited to these sites. The data are presented in Table 17.3 for blades (these include blades *sensu stricto* and do not incorporate the bladelets) and in Table 17.4 for flakes. There seems to be no obvious patterning when comparing the values in these tables other than the fact that blades and flakes from Fazael IX are always smallest while Ein Aqev East has the largest blades.

In order to search for patterning, tests for statistically significant differences between varying combinations of assemblages were carried out through one-way analyses of variance. The first hypothesis tested was that assemblages from a single technological tradition would exhibit similar metric attributes. In other words, those from the Ahmarian sites of Fazael X and Ein Aqev East should be similar, as should those from the three Aurignacian assemblages. A one-way ANOVA test, however, gave different results (Table 17.5). When comparing length, width and thickness of both blades and flakes between the two Ahmarian sites, significant differences were observed for all the attributes. The same was true for the three Aurignacian sites with the exception of blade width that shows a non-significant difference at slightly above the .05 level.

Similar analyses were also done on a regional basis comparing the Negev sites to each other and those of the Jordan Valley to each other (Table 17.6). For the Negev sites of Ein Aqev and Ein Aqev East, no significant differences and no inter-site variability in artefact size could be discerned. When the Jordan Valley sites were compared, a slightly different picture emerged. The blades showed no inter-site variability but there were significant differences for the flake attributes. This is the result of the distinctly smaller flakes from Fazael IX, a fact that is most likely related to the specialized nature of this occupation. No significant differences were observed between the other two Jordan Valley sites.

In sum, the artefacts from the Jordan Valley sites are considerably smaller than those from the Negev. Thus regional differences crosscut the two traditions at least for the sites compared here. This can be explained by the relative abundance of flint in the two regions. While flint

Table 17.3 Mean metric attributes for blades.

		Length		Width		Thickness	
	N	Mean	SD	Mean	SD	Mean	SD
Ein Aqev East	130	62.79	22.19	23.25	6.49	8.06	4.33
Ein Aqev	208	49.34	27.85	33.13	10.70	6.26	4.35
Fazael IX	57	44.63	17.02	17.03	7.43	5.08	2.47
Fazael X	170	51.49	15.28	20.19	5.77	5.16	2.63
Nahal Ein Gev I	58	48.01	14.43	20.36	7.23	6.81	3.44

Table 17.4 Mean metric attributes for flakes.

		Length		Width		Thickness	
	N	Mean	SD	Mean	SD	Mean	SD
Ein Aqev East	232	39.42	16.19	31.72	12.99	7.61	4.31
Ein Aqev	373	37.93	18.14	33.13	14.96	8.06	5.05
Fazael IX	163	22.26	8.53	23.13	7.53	5.38	5.62
Fazael X	627	31.87	13.72	28.25	12.12	5.52	2.96
Nahal Ein Gev I	173	33.11	15.76	27.56	10.64	7.14	4.49

Table 17.5 ANOVA results for comparisons of metric attributes within traditions.

	Length		Width		Thickness	
Blades	F	p	F	p	F	p
Ein Aqev East/Fazael X	10.93	.001	4.64	.032	32.58	.000
Ein Aqev/Fazael IX/Nahal Ein Gev 1	6.11	.003	2.67	.065	4.82	.009
Flakes						
Ein Aqev East/Fazael X	46.14	.000	13.13	.000	64.97	.000
Ein Aqev/Fazael IX/Nahal Ein Gev 1	55.55	.002	38.59	.000	15.79	.000

Table 17.6 ANOVA results for comparisons of metric attributes within regions.

	Length		Width		Thickness	
Blades	F	p	F	p	F	p
Negev	0.41	.522	1.89	.169	.719	.397
Jordan Valley	0.59	.552	.016	.984	7.42	.000
Flakes						
Negev	1.05	.305	1.39	.238	1.24	.266
Jordan Valley	37.43	.000	13.93	.000	13.17	.000

is essentially ubiquitous and was readily available in the Negev (Munday 1976), it was less so in the Jordan Valley either because fewer outcrops existed, that the outcrops were situated at some distance from the sites (J. Schuldenrein personal communication) or that the available nodules were relatively small. The same probably holds true for Shunera XVI as it may be that raw materials were less ubiquitous in the lowland dune areas in comparison to the Negev Highlands but this needs to be further examined. In any case, raw material availability and quality must have had an impact on curation habits and technological adaptations and may explain some of the variability seen between the sites within each tradition, and in particular, the Ahmarian.

Conclusions

To summarize, it can be seen that the two lithic traditions vary in two important ways, in addition to the differences in basic technology. First is the fact that the Aurignacian can be characterized as a logistically organized or radiating system of mobility consisting of generalized

habitations or base camps and specialized activity or satellite camps. The Ahmarian, on the other hand, lacking evidence for specialized activity camps most likely operated within a system of residential or circulating mobility. Sites here tend to have more generalized toolkits.

Second, there is variability in the exploitation of raw materials. The Aurignacian shows a tendency for off-site production and curation of blanks from workshops transported to habitation sites with a resulting high rate of utilization of available blanks. The Ahmarian, in contrast, exhibits a different pattern. This system, too, is based on curation of blanks, but of a very specific form, the bladelets. Whereas the Aurignacian system involved the movement of materials from a raw material source to the habitation, the Ahmarians carried prepared cores and blanks throughout their range from habitation to habitation.

What we are seeing here are the interdependencies between technology and settlement. The more mobile system of the Ahmarian was, in a sense, dependent on a very prolific and easily transportable technology. The Aurignacians, being somewhat more sedentary, were able to adapt by carrying materials over relatively shorter distances and did not require transportability. Even so, this tradition did make more efficient use of those materials that were brought to the habitation sites.

It is recommended here that these characteristics be utilized in expanding our definitions of the two lithic traditions and that they be included together with their techno-typological attributes. Technology is a cultural trait, and so, too, are settlement patterns and means of raw material exploitation. If it is our objective to define and describe cultures, we should include as many distinguishing characteristics as possible. A point being stressed here is that mobility patterns are culture specific, at least for the entities under consideration here. It is true that Binford (1980) noted that residential and logistical mobility are not mutually exclusive and they are best viewed as extremes on a continuum. He also stated that any given group may employ a combination of the two systems. However, this does not negate the possibility that some cultural entities did, indeed, operate within a single system to the exclusion of the other. The absence of specialized activity sites for the Ahmarian lends strong support to this notion.

Finally, the patterns described here seem to hold for these sites attributed to the closing stages of the Upper Palaeolithic. As noted earlier, it is quite possible that shifts occurred through time. However, given the high degree of technological continuity through a considerable period of time for each of the traditions, it may be expected that the adaptations outlined above may also have remained somewhat constant through time. Unfortunately, this will remain an open question until we have a more refined chronology making it possible to make similar kinds of comparisons on a larger sample of sites both within and between traditions and regions.

Acknowledgements

First, my appreciation goes to Nancy Coinman who kindly provided unpublished artefact counts from her most recent excavations at Ain el-Buhira. Avraham Ronen and Mina Evron consented to read an earlier version of the paper and their comments were most helpful.

18. The Ohalo II Flint Assemblage and the Beginning of the Epipalaeolithic in the Jordan Valley

Dani Nadel

Introduction

The first descriptions and interpretations of southern Levantine Upper Palaeolithic flint assemblages were based on excavations in caves and rock shelters in the Judean Hills, Mt. Carmel and Galilee (Garrod and Bate 1937; Garrod 1957; Neuville 1951). A unilinear scheme of cultural development was then proposed. Twenty years after, the separation of the microlithic-rich assemblages from the Upper Palaeolithic sequence resulted in the introduction of a new term, the Epipalaeolithic (Perrot 1968; Bar-Yosef 1970). Additional works have demonstrated a wide range of inter-assemblage variability. By the early 1980s, it became commonly accepted that there are two distinct Upper Palaeolithic lineages, with the Ahmarian beginning earlier and probably ending later than the Levantine Aurignacian (Gilead 1981a; Marks 1981a; Belfer-Cohen and Bar-Yosef 1999; and see papers in this volume).

These distinct knapping traditions were commonly distinguished by two main characteristics. The first characteristic concerns the preferred blank type, namely the flake, and to a lesser degree the thick blade in the Levantine Aurignacian, and the blade/let in the Ahmarian. The second characteristic concerns tool types. The Ahmarian assemblages are dominated by pointed and retouched blade/lets, with high frequencies of Ouchtata bladelets especially during the later Ahmarian. The Levantine Aurignacian is relatively poor in these types, while scrapers and burins (including carinated types) dominate.

The Epipalaeolithic cultures were defined according to the types and relative frequencies of retouched bladelets, which dominate all Epipalaeolithic assemblages. For years it was believed that in southern Levantine Epipalaeolithic assemblages Ouchtata retouch is absent or rare, while backed bladelets of various shapes comprise the dominant types (see Bar-Yosef 1970; Goring-Morris 1987; Henry 1989a; though see Hours 1973 for the *Kébarien ancien* in Lebanon). However, it was later suggested that what could be termed (today) early Epipalaeolithic assemblages in the south do contain large proportions of Ouchtata bladelets. These were grouped together as Late Ahmarian (Gilead 1981a; Marks 1981a) and later as the Masraqan industry (Goring-Morris 1995b).

Discussion concerning Upper Palaeolithic and Epipalaeolithic cultural definitions based on flint assemblages still continues (see this volume). It appears that there are four major issues to be addressed:

A. The inter-assemblage variability observed in the large number of reported cases is indeed high. This is especially true for the retouched specimens, and within this group the microliths are particularly variable.
B. Several type-lists are available. They are identical in most categories, with differences only in a small number of types (see Bar-Yosef 1970; Hours 1974; Marks 1976b, c; Goring-Morris 1987; Fellner 1995; Nadel 1997a, b). This reflects both the high inter-assemblage variability, as well as personal perceptions and meticulous efforts to best describe each assemblage.
C. Many assemblages used in the ongoing discussions derive from test trenches. This is to say that due to preservation conditions or fieldwork limitations, the Levantine flint assemblages used for describing and defining prehistoric cultures derive from limited samples (see Kerry 2000). Only in rare cases were the assemblages retrieved from clearly defined and sealed features (floors, pits, graves, *etc*.). The direct implication is that in many instances the flint assemblages presented in the literature may not reflect the entire range of activities and their locations within a given site.
D. The issue of chronology is not fully resolved. Although there are some sites with stratified sequences and the number of dated sites/layers is growing continuously (*e.g.*, Bar-Yosef and Vogel 1987; Byrd 1994, 1998; Garrard *et al*. 1994; Goring-Morris 1995b), certain important sites still remain with no radiometric dates. Thus, their exact placement

within the chronological framework may be questioned.

With these limitations in mind, it is also important to remember that the original definitions of some cultural entities were proposed long ago. Since then, many new sites have been studied, and their assemblages could not be easily accommodated within the previously established frameworks. Currently, the situation is such that there is lack of agreement as to the parameters to be used for clearer cultural definitions. Suggestions of wider techno-typological studies and the incorporation of non-lithic materials have been advanced. These lines of thought are well known, and have been addressed elsewhere and in this volume. However, since in many sites flint artefacts are often the exclusive finds preserved or presented in detail, dependence on these for cultural assignment is still widely practiced.

The aim of this paper is to address the issue of the Upper Palaeolithic – Early Epipalaeolithic transition as seen from the Ohalo II lithic assemblages. It is believed that the presentation of certain aspects of the *in situ* and radiometrically dated assemblages from Ohalo II (with brush hut floors, hearths, *etc*.) will provide a different angle to some of the issues in debate. Specifically, the implications are relevant in three ways. First, spatial distributions at Ohalo II are considered, as samples from particular features may not always represent the entire site. Second, some tool types show affinities to both Kebaran and Late Ahmarian traditions. Accordingly, a short discussion of these two traditions in the Jordan Valley is presented, with an emphasis on selected tool types. And last, the variety of non-lithic finds enables an attempt at correlating the lithics to a specific settlement strategy.

The Ohalo II excavations have exposed an area of more than 500 m^2, in which a variety of *in situ* features was documented. The camp includes the remains of at least six brush huts, a grave, several concentrations of outdoor hearths, a stone installation and a pit. The floors and hearths do not exceed 10–30 cm thickness (Nadel 1994, 1995, 1996, 1997b; Nadel *et al*. 1994). The brush huts are oval in shape and the bases of their burnt walls were clearly visible during excavations (Nadel and Werker 1999).

A large quantity and a wide variety of burnt plant remains, including thousands of charred seeds, has been found on the floors and in the hearths (Kislev *et al*. 1992; Simchoni 1997). A wide range of animal remains has been retrieved and studied. The most common species are fish, gazelle and birds (Nadel *et al*. 1994; Rabinovich 1998b; Simmons and Nadel 1998). The floral and faunal food residues reflect a broad-spectrum economy and year-round occupation at the camp.

Thirty ^{14}C dates are now available from more than 10 archaeological features, of which 25 have been published, with an average of 19,400±770 bp (Nadel *et al*. 1995).

The Ohalo II Flint Assemblage

Technological Aspects

The flint assemblage was found in fresh (sharp) condition both in the loci and on the surface. The assemblage was retrieved by wet sieving all excavated sediments through a 1 mm mesh (surface material through a 2 mm mesh). The total weight of the *in situ* flints is *ca*. 70 kg with *ca*. 16,500 artefacts (loci 1–9 of the 1989–91 seasons, Table 18.1), and the number is more than double when the 1999–2000 material is included (as yet still under study).

Locally available rolled pebbles were used for the production of flint artefacts. Only 34 cores were found in

Table 18.1 The in situ *flint assemblage from Ohalo II (1989–91 seasons). Note the relatively low percentage of bladelets in Locus 5, which is actually a grave fill.*

	Loc 1	Loc 2	Loc 3	Loc 4	Loc 5	Loc 6	Loc 7	Loc 8	Loc 9
N =	3,099	1,365	6,714	322	525	200	3,450	524	261
Tools	6.9	4.5	3.1	6.5	4.6	4.5	3.8	4.0	4.6
Cores	0.4	0.1	0.1	–	–	–	0.2	0.2	0.8
Bladelets	45.7	47.6	48.1	47.2	35.6	45.0	43.8	50.8	46.0
Blades	10.4	8.7	11.0	13.0	13.9	13.5	7.2	9.0	11.5
Flakes	22.3	22.3	24.0	18.3	29.0	29.0	31.6	21.6	24.9
Primary elements	10.0	10.5	9.0	9.0	11.2	5.0	8.6	9.5	6.5
Burin spalls	0.5	0.8	1.1	1.6	0.4	0.5	0.9	0.6	
Core trimming elements	3.8	4.5	3.5	3.4	5.3	2.5	3.9	4.4	5.7
Total	100.0	99.0	99.9	99.0	100.0	100.0	100.0	100.1	100.0

loci 1–9, and thus a sample of 201 surface specimens was also studied (Fig. 18.1:1,6–9). Most cores are less than 55 mm long (74% *in situ*, 80% surface finds). According to the cortex remains on many cores, these were made on small pebbles. However, there are isolated examples of flake and blade cores longer than 70 mm, reflecting a reduction sequence distinct from the small bladelet cores. The cores are usually complete (71%) and 10% of them have fire cracks on their surface.

The bladelet cores include three main types, according to their general shape: narrow, pyramidal and irregular (the latter include exhausted as well as broken specimens). The narrow bladelet core dominates the assemblage (though this varies considerably between loci). It has a single sub-oval striking platform, but proportions and dimensions vary. The narrow shape was achieved by simply choosing a narrow pebble, and/or by removing two to three lateral primary flakes.

In terms of striking platform numbers, the most common core has a single platform (38%). Changed orientation cores are also common (30%) while two opposed platforms are relatively rare (5%). Three platforms also occur (21%) and irregular or broken specimens complete the list.

When scar types are counted, it is clear that the bladelet was the most desired product. Altogether there are 61 cores with bladelet scars, and 105 (71%) cores with bladelet and flake scars. Many of the flake scars are the result of narrowing and shaping the core. Flake cores compose 24% of the studied sample. It should be stressed that the bladelet scars are mostly twisted.

A final point regarding the cores concerns the definition of the *rabot* type. By one approach the core-scraper is counted as a tool, while by the other it is viewed as a core. Bar-Yosef (1970) defined two core-scrapers in his type list (#18–19, in addition to two carinated items, #16–17) and Hours too included the core-scraper in his type list (Hours 1974). Goring-Morris (1980a) and Bergman (1987a:12), in their consideration of carinated items, distinguished between the specimens made on chunks (= cores) and those made on flakes (= carinated tools). Ferring stated that the separation of thick scrapers from cores '… was somewhat arbitrary… and decisions were made intuitively…' (Ferring 1977:95). At Ohalo II there are 40 specimens of the *rabot* type with a certain degree of 'scraper' retouch along their edge. They have all been counted as cores.

There are 653 *in situ* core trimming elements, which together with the relatively low number of cores seems to indicate that some were discarded outside the excavated loci. Core tablets are extremely rare indicating that removing a slice of the entire platform for a second series of bladelet production was hardly practiced. The most common product of core shaping is a 'partial' ridge bladelet (or a small blade). Such a bladelet carries along the distal end (mostly only along a third or fourth of the total length) typical ridge blade scars, usually along one side (Fig. 18.1:2–5,10). Sometimes the scars are small and angular, reflecting platform preparation by abrasion. In many cases these bladelets are curved or twisted.

It should be noted that relatively large blades, flakes and core trimming elements (some are 7–10 cm long) were found in small numbers. These could never have been produced in the reduction sequence of the bladelet cores described above. Thus the cores and other debitage categories attest to two methods of blank production at the site.

Bladelets are the most frequent product in all parts of the site, 46% of the debitage. The highest percent of use for tool blanks is recorded for this category, as 6% of them are retouched. If blades are grouped with the bladelets (usually these are small and often irregular in shape), they form together more than 50% of all products in each locus. More than 85% of the bladelets are broken, most frequently near the tip. Most are twisted to some degree, and 31.5% of the retouched specimens are twisted. The twisted bladelets are mostly twisted to the right. Flakes constitute 25% of the debitage, while primary elements form 9% of the assemblage.

Two comments regarding the bladelets are relevant. First, the bladelet definition differs from that of Tixier (1963), as the *width* boundary was set at 10 mm, there being very large numbers of narrow bladelets in the assemblage. Also, the minimal length was set at 10 mm and not 15 mm. To illustrate the inappropriate dimension boundary of Tixier (to the Ohalo II bladelet assemblage) two points should be emphasized. First, a flint sample from Locus 1 was studied in both ways. According to Tixier's definition, the sample includes 111 bladelets (Table 18.2). However, there are also 120 bladelets 10–15 mm long. Counts according to Tixier completely ignore this large number of items. Second, when all bladelets longer than 10 mm are plotted, there is no clear boundary between smaller and larger bladelets (Fig. 18.2), and there is definitely no boundary at 15 mm.

The minimal dimension boundary used here raises the relative frequency of bladelets within the total debitage counts (from 31.4% to 43.8%), but has a minimal effect on counts of all other categories (less than 5%). The dimensional boundaries used here differ from many Levantine works where the minimal blank length was set at 15 mm (*e.g.*, Marks 1976c; Goring-Morris 1987). However, as there are publications with 20 mm (Bar-Yosef and Phillips 1977: Table 2) and 10 mm (Byrd 1989) boundaries, as well as definitions according to the *area* of the blank (Calley 1986; Valla 1984:24), the issue of inter-assemblage debitage comparisons remains problematic (Kaufman 1987).

Typological Aspects

Retouched pieces form 4–6% of the assemblage in each locus, with a total of 731 specimens (1989-91 seasons, Table 18.1). A surface sample of 1,865 tools is also

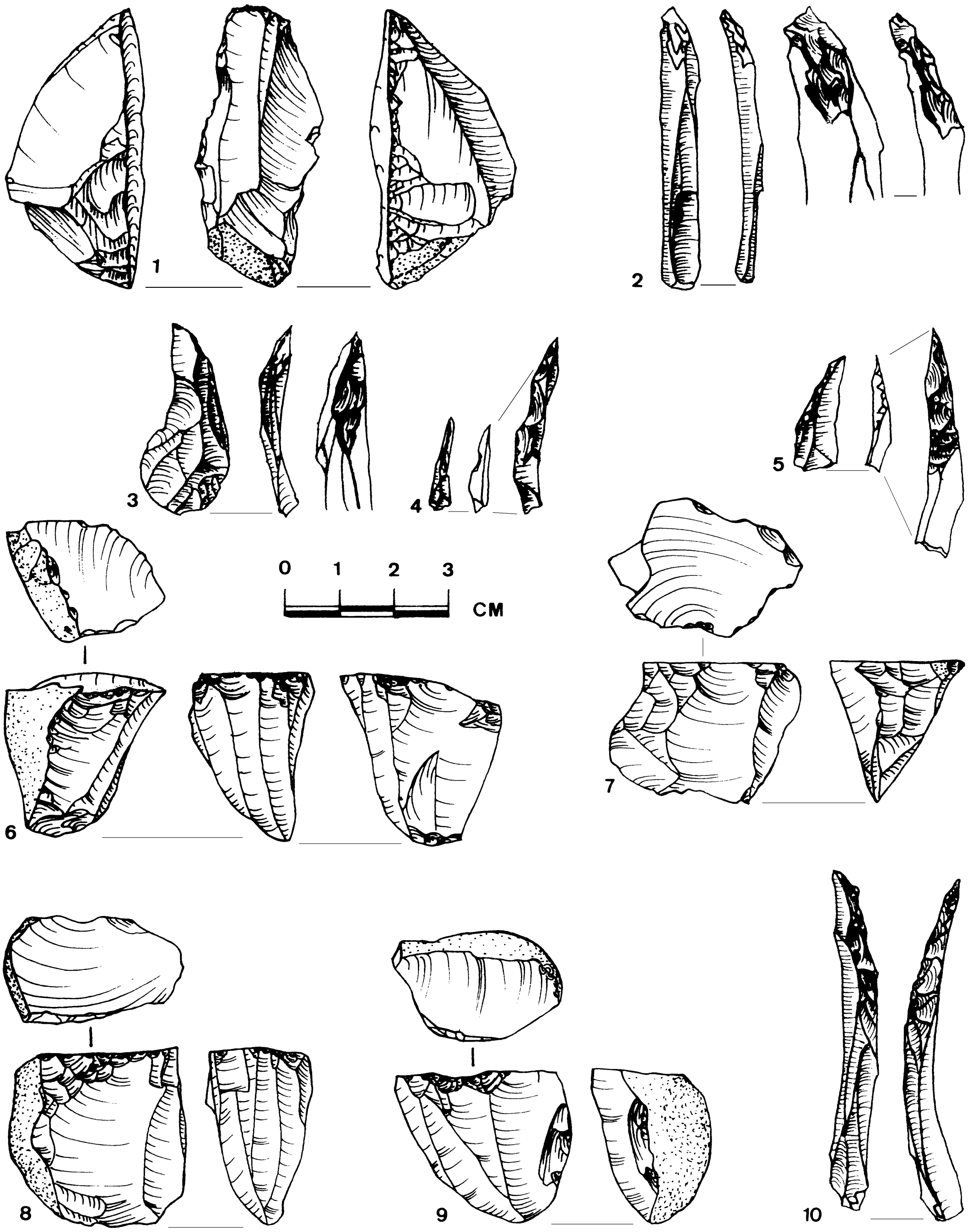

Fig. 18.1 1, 6–9, Bladelet cores; 2–5,10, Core trimming elements. Note that specimens 2–5 are enlarged on the right.

included in this study. It should be noted that there seems to be a low standard of manufacture for each tool type, and the range of variability in terms of shape and dimensions within each type is very high.

A. Macroliths

The macroliths form about a third of the *in situ* tools (Table 18.3, Fig. 18.3). The frequency of cortex (over 25% of the dorsal face) is high (30%) and the kind and location of retouch vary considerably within each type. The curated types, like the burin and endscraper, are not common. They comprise together only 4.5% of the *in situ* tools. Short comments regarding the major types are presented below.

Endscrapers are rare in the Ohalo II assemblage. Within the *in situ* features there are only six scrapers (out of 731 tools), and three of these are fragments or on broken pieces. There are no endscrapers on blades.

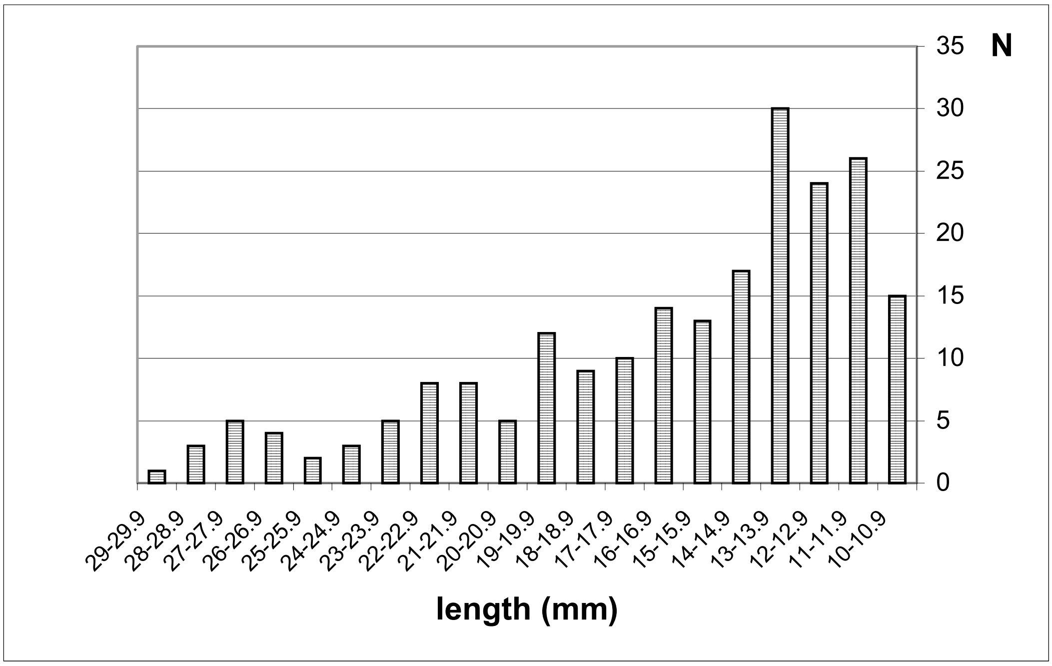

Fig. 18.2: Length of bladelets from Locus 1 at intervals of 1 mm.

Table 18.2 Two debitage counts of a sample from Locus 1. The first count follows Tixier (1963) and includes all specimens longer than 15 mm, while the other is based on minimal lengths of 10 mm.

	>15 mm	%	>10 mm	%
Bladelets	111	31.4	231	43.8
Blades	65	18.4	74	14.0
Flakes	111	31.4	145	27.5
Primary Elements	50	14.1	57	10.8
Burin Spalls	1	0.3	3	0.6
Core Trimming Elements	16	4.5	17	3.2
Total	354	100.1	527	99.9

Scrapers form 2% of the surface assemblage, also a low proportion in comparison to most Late Upper Palaeolithic and Early Epipalaeolithic assemblages in the southern Levant.

Burins form 3.7% of the *in situ* finds and 4.6% of the surface assemblage. They are made on blades and flakes in similar numbers. The simple burin, on a break/natural surface is the most common, closely followed by the dihedral type. Other types, including carinated burins, are rare.

Retouched blades are the most common macrolith at the site (80 *in situ*, 290 total). Retouched ridge blades are also included here (n=17). Almost 60% of the specimens are 26–49 mm long, reflecting the small size of most blades. The type and location of the retouch vary considerably, though the most common is partial simple retouch.

Points (blades). Only one small pointed blade was found on the surface. Several irregular specimens were also recovered. However, as the retouch was irregular or on a very short portion of the blade, these pieces were not considered as true points.

B. Microliths

The Ohalo II microliths weigh less than 1% of the flint assemblage and only 9% of them are complete (Fig. 18.4). The bulb of percussion is still present on half of the specimens, and such is also the proportion of the twisted

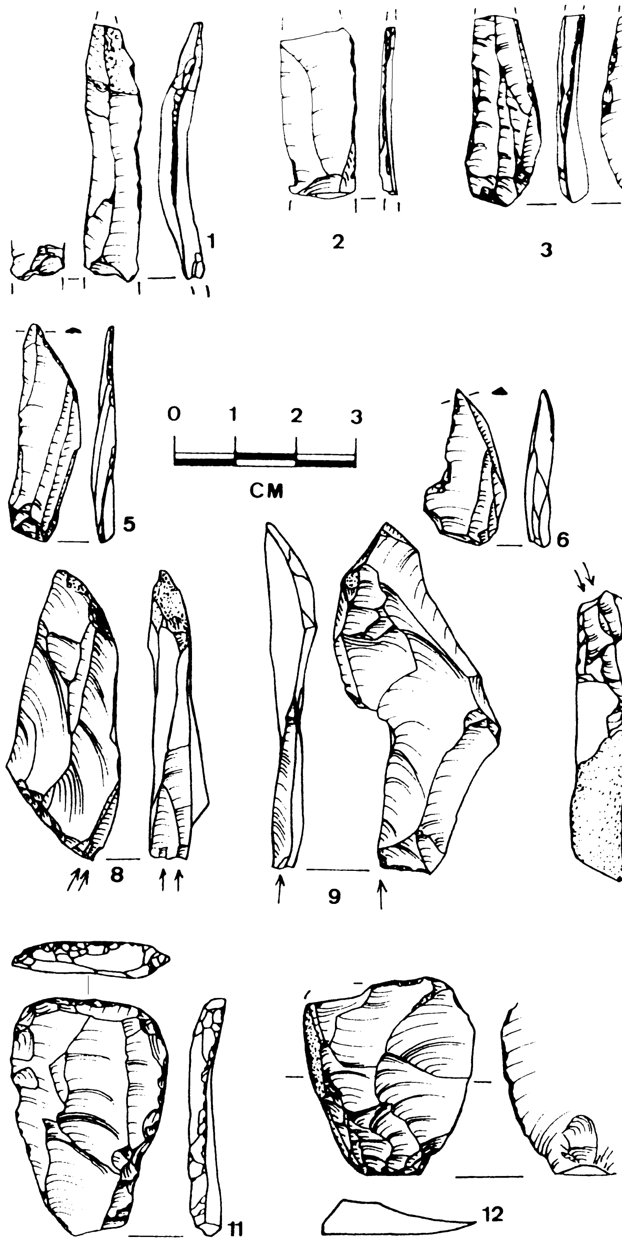

Fig. 18.3 1–4, Retouched blades; 5–7, Awls; 8-10, Burins; 11, Endscraper; 12–13, Retouched flakes.

bladelets. The right edge was retouched in 84% of the cases.

The most common specimens are the partially retouched bladelets (24%) most of which are delicately retouched (Table 18.4). However, it is the combination of Ouchtata and backed bladelets that is the hallmark of the Ohalo II assemblage. It should be pointed out, that, as in the macrolithic group, the kind and location of retouch vary considerably within each tool type. Accordingly, the boundaries between related types are rather arbitrary. Furthermore, in some cases one type of retouch grades into another, and in some specimens Ouchtata and abrupt retouch were found along the same edge.

The microliths can be divided into two groups according to the impact of retouch on the blank. The first is a group of microliths where the retouch did not alter or modify the shape of the bladelets. The types belonging to this group include all the specimens with Ouchtata and simple (as opposed to semi-abrupt and abrupt) retouch. Ventral retouch is uncommon (5%), and includes eight Dufour bladelets. Altogether these comprise 35% of the retouched bladelets.

Table 18.3 Tools from loci and surface at Ohalo II.

	Loci	%	Surface	%	Total	%
N	731		1,865		2,596	
Endscrapers	6	0.8	39	2.1	45	1.7
Burins	27	3.7	86	4.6	113	4.3
Awls	14	1.9	35	1.9	49	1.9
Retouched blades	80	10.9	209	11.2	289	11.1
Truncations	9	1.2	15	0.8	24	0.9
Notches Denticulates	32	4.4	122	6.5	154	5.9
Points			1	0.1	1	0.0
Retouched flakes	40	5.5	151	8.1	191	7.4
Multiple tools	9	1.2	26	1.4	35	1.3
Microliths	504	68.9	1133	60.8	1637	63.0
Varia	10	1.4	48	2.6	58	2.2
Total		99.9		100.1		99.7

The second group comprises items where the retouch clearly modifies the morphology of the blank (*e.g.*, abrupt or semi-abrupt retouch). Types here account for 23% of the microliths. Among the backed specimens, there is no single dominant type, as most types form only 1–3% of the microliths. Relatively common are the pointed types, with a straight or curved back (together *ca*. 9%). The micropoint is very rare, with only three examples. Truncated bladelets are also rare, and so are obliquely truncated backed bladelets (n= 5). Backed pieces without a pointed tip are also present (4%) as well as micro-awls (n= 15).

The proto-triangle/scalene triangle is of particular interest (Nadel 1999). The triangular shape was formed by a somewhat diagonal retouch along one edge, and an oblique truncation of the distal/proximal end (Fig. 18.4:8–12). It is the only type where all specimens were made on straight blanks. Sixteen of the *in situ* specimens are complete (67%), a ratio much higher than the ratio observed for any other type of microlith. The most common retouch is abrupt, though in eight cases it grades into simple and even fine Ouchtata retouch. It is noteworthy that sometimes the retouch is not continuous along the full length of the edge. There seemed to be a tendency to modify the right edge more than the left one. The average length (21.6 mm) is similar to the average length of all other microlith types though the average width (7.8 mm) is greater than that recorded for other types (most of which are 5–7 mm wide). There is a wide range of variability in size, and the length:width proportions also vary considerably. Some specimens appear to be intermediate between proto-triangle/scalene triangle and *lamelle scalène* (or other types).

The retouched bladelet fragments form *ca*. 20% of the microliths. They are mostly shorter than 17 mm. Here, again, Ouchtata retouch is dominant (*ca*. 70%), as well as the right side retouch. Backed fragments are also common (9%). Together, the fragments form almost a third of the retouched and backed bladelets.

The high frequency of fragments is illuminating. Many derive from sealed and excellently preserved contexts (brush hut floors and hearths) where delicate charred remains and articulated bones were preserved *in situ* (Nadel *et al*. 1994; Nadel 2000). It is thus clear that trampling and post-depositional processes did not cause most of the observed breaks. This suggests that large numbers of microliths broke during preparation, hafting or maintenance of composite tools.

Bifacial Technology

During the process of studying the Ohalo II lithics, it became apparent that tools fashioned in a bifacial method are present. These are rare or absent in Upper Palaeolithic – Early Epipalaeolithic (pre-Natufian) sites in the southern Levant. The bifacial technology was used to modify flint and limestone, each for a distinct type of tool.

Two bifacially flaked flint specimens were recovered so far. One was found in the centre of the upper floor of hut 1 (Fig. 18.5:2) and the other was collected from the surface. Both specimens are complete, bear no signs of rolling and are similar in dimensions and shape. They have sharp edges and are flaked on both faces. The raw material of both was commonly used in the local industry. As they are bifacially worked and have a regular sharp edge, they are termed bifaces and not keeled cores or *varia*. A detailed description will be presented elsewhere.

The limestone category includes four complete specimens found *in situ* (Fig. 19.5:1), three broken *in situ* specimens and seven examples collected from the surface of the site. In addition, there are several *in situ* pieces

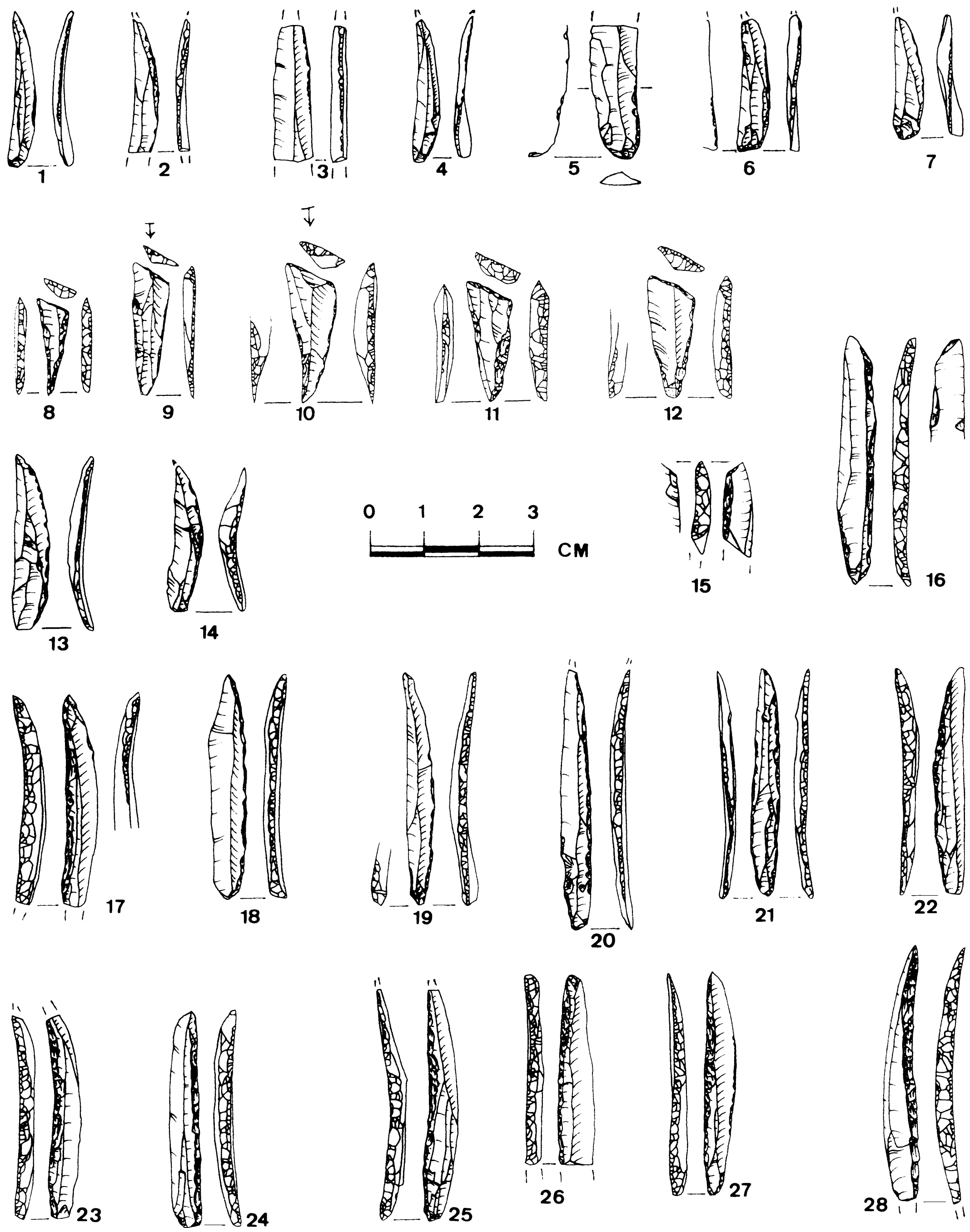

Fig. 18.4 1, 4–7, Ouchtata bladelets; 2–3, Retouched bladelets; 8–12, Proto-triangles; 13–14, Micropoints; 15–16, Obliquely truncated backed bladelets; 17–28, Various pointed backed bladelets.

typical of bifacial debitage and many limestone flakes of various dimensions, including specimens similar in size to the scars on the bifacial tools.

The complete specimens are oval and *ca.* 10 cm long. They all have two opposed notches on their sides, though never symmetrical in size. They are partially or fully covered by bifacial flake scars, and in some examples there are retouch and use scars on the shorter edges. Similar examples from the Upper Palaeolithic through the Early Epipalaeolithic in the Near East were reported from Nazlet Khater 4 in Egypt, *ca.* 33,000 bp (Vermeersch *et al.* 1984, 1990). There, too, they were rare, and described as tools rather than cores.

Some of the Ohalo II limestone bifaces seem to have been used as fishing net sinkers. This is yet to be verified, but the presence of hundreds of thousands of fish bones

Table 18.4 Microliths from loci and surface at Ohalo II.

Type	Loci	Surf	Total	%
Partially retouched bladelet	119	118	237	24.4
Completely retouched bladelet	2	3	5	0.5
Alternately retouched, both edges	26	20	46	4.7
Ventrally retouched, Dufour	28	22	50	5.1
Micropoint	1	2	3	0.3
Backed (partial) bladelet	11	17	28	2.9
Completely backed, straight, pointed bladelet	11	40	51	5.3
Truncated bladelet	18	6	24	2.5
Truncated and retouched bladelet	10	4	14	1.4
Obliquely truncated, backed bladelet	2	3	5	0.5
Arched bladelet, pointed	9	5	14	1.4
Arched bladelet, blunt	12	31	43	4.4
Pointed bladelet, both ends	12	13	25	2.6
Micro-awl	8	7	15	1.5
Proto-triangle	24	7	31	3.2
Microgravette	–	2	2	0.2
Notched-denticulated bladelet	21	12	33	3.4
Bladelet, *varia*	41	30	71	7.3
Retouched bladelet fragment	111	80	191	19.7
Backed bladelet fragment	38	45	83	8.5
Total	504	467	971	99.8

as well as cord fragments (Nadel *et al.* 1994) do suggest that fishing nets were used. Other specimens could have been hafted to handles, serving as hammers or crude axes.

Intra-site Variability

The general debitage counts from *in situ* and surface material are remarkably similar, regardless of sample size (Fig. 18.6). These include samples from hut floors, concentrations of hearths and a small pit. It should be noted that small knapping debris (<10 mm) is also abundantly found in all loci at the site. Apparently, flint knapping took place everywhere, as an indoor and outdoor activity. Lithic production does not seem to have been spatially segregated.

These results indicate that a much more limited excavation at the site (one locus, and to a certain degree even a systematic surface collection) would have yielded a representative assemblage of the debitage. Such a conclusion supports the validity of sampling a site by a trench excavation and surface collection, provided the site did not suffer serious post-depositional disturbances. Still, a different conclusion was reached for the Jebel Humeima (J412) Early Ahmarian site in Jordan (Kerry 2000).

However, at Ohalo II the typological picture is not similar to the one demonstrated by the debitage counts. In general terms, all samples are very similar in that they are all dominated by microliths, with both finely retouched bladelets and backed types occurring together. Nonetheless, there are important exceptions. For example, the proto-triangle forms *ca.* 10% of the microliths in Locus 1 but is completely absent from most other areas (Nadel 1999). Also, scrapers are completely absent in Locus 1. The limestone bifaces were found in small numbers in some locations, and they are missing in many others. These examples indicate that the retouched assemblage from a narrow trench through one or two loci (or from the surface) would not represent the full range of the Ohalo II tool kit. As the assemblages derive from well-sealed *in situ* features, the results presented here should be borne in mind when inter-site studies are conducted. From another angle, a cautionary example was reported from the Nahal Neqarot Ramonian site in the Negev. Here, the tools found on the surface were originally thought to

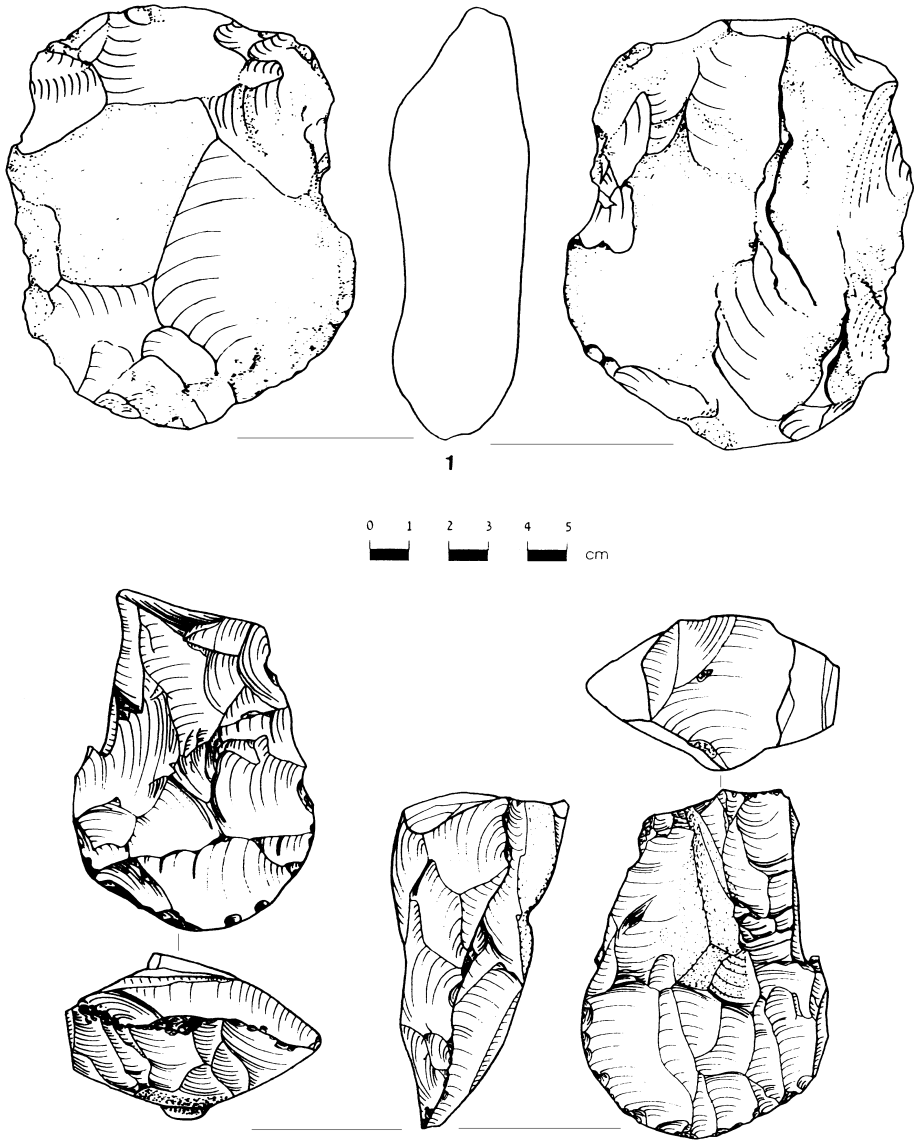

Fig. 18.5 1, Limestone pebble with crude bifacial modification and two opposed notches; 2, Flint biface.

belong to two cultural entities. Excavations showed that there is only one culture present, responsible for the production of the supposed two industries (Belfer-Cohen *et al.* 1991; Belfer-Cohen 1994).

Jordan Valley Upper Palaeolithic – Early Epipalaeolithic Assemblages

A comparison of flint assemblages of the Late Upper Palaeolithic and Early Epipalaeolithic entities in one area is generally expected to reflect certain regional patterns of raw material use and cultural adaptations to similar environments. This section compares certain typological aspects of flint assemblages deriving from sites located in the Central and Lower Jordan Valley in order to point out similarities and differences between assemblages ascribed to various cultures. The sites are not numerous, and included here are only the microlith-rich assemblages. The Fazael X–XI sites were initially viewed as Upper Palaeolithic but later ascribed to the Masraqan Early Epipalaeolithic (one date: 15,450±130 bp, Goring-Morris 1980a, 1995b; Housley 1994). Epipalaeolithic Kebaran sites include Ein Gev I (15,700±415 bp, Bar-Yosef 1970), Urkan e-Rubb IIA (nine dates *ca.* 15,000 bp, Hovers and Marder 1991), Fazael IIIA, IIIB and VII (no radiometric dates, Bar-Yosef *et al.* 1974; Goring-Morris 1980a) and Wadi el-Hammeh 26 (19,500±600 bp, Edwards 1990; Edwards *et al.* 1996).

No debitage comparisons are included in this short study and the focus is on three main tool classes. These

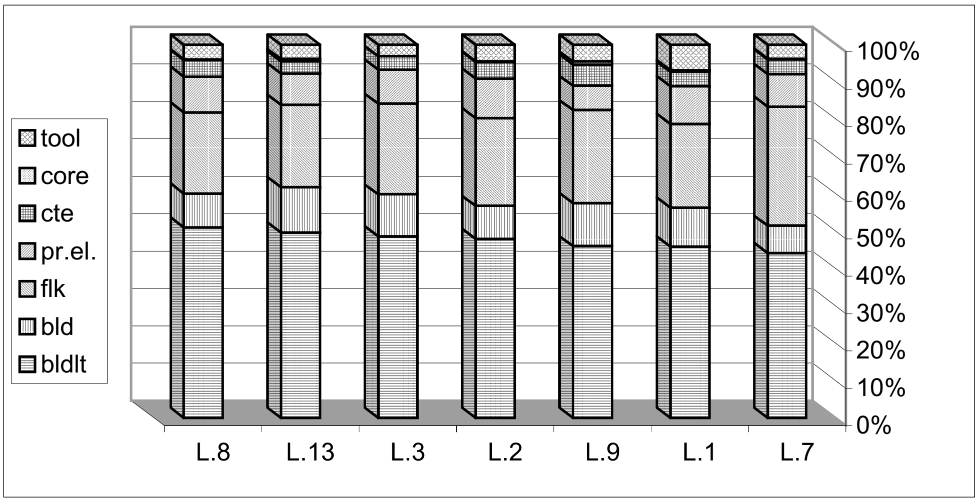

Fig. 18.6 Debitage counts for assemblages from sealed floors (loci 1–3,13), hearths (loci 7, 9) and a pit (Locus 8). Note that cores comprise less than 1%.

classes (scrapers, burins and microliths) have usually been used in defining Levantine Upper Palaeolithic – Epipalaeolithic cultural entities.

The scrapers vary between 1.6–20.3% of the retouched tools, the burins 3.6–13.7% and the microliths between 34.6–85.8% (Table 18.5). To better illustrate the variability, and to isolate these tools from their relative proportions to *ad hoc* types, the microlith:scraper ratios have been calculated (Table 18.6). The ratios for the Kebaran assemblages range between 1.7 (Ein Gev I) and 40.25 (Fazael IIIA). At Ohalo II, the values of three loci are 24.7, 71.0 and 179.0 (the last value is actually not a ratio, as there are no scrapers in Locus 1). The results show that the ratios of Fazael X–XI and Ohalo II partially overlap with the Kebaran examples. However, they also show a very high range of variability within the Kebaran sites, even when located near to one another (*e.g.*, Urkan e-Rubb IIA and Fazael). Furthermore, the Ohalo II examples represent high intra-site variability. Thus, the microlith:scraper ratio does not reflect a cultural-specific pattern.

When the microlith:scraper+burin ratio is studied, the Kebaran sites range between 1.0 and 15.9, with no clear clustering of sites (Table 18.6). Fazael X falls in the middle of the Kebaran range, while the Ohalo II ratios fall within the higher Kebaran range (Table 18.6b). Again, the ratios between the three tool classes could not be used to distinguish Fazael X and Ohalo II from the Kebaran assemblages. A similar conclusion, based on percentages of burins and scrapers, was reached by Kerry (2000: Fig. 9), who compared assemblages from Early Ahmarian, Late Ahmarian, Aurignacian and non-Aurignacian sites in the southern Levant.

Discussion

It has been common to use distinct microlithic types (guide fossils) in the process of culture identifications within the Levantine Late Upper Palaeolithic – Early Epipalaeolithic chronological framework. For example, the Kebaran was primarily identified and chronologically subdivided according to frequencies of micropoints and obliquely truncated backed bladelets (Bar-Yosef 1970 and many others). Relevant to the discussion of the Upper Palaeolithic to Epipalaeolithic transition in the Jordan Valley are the Ouchtata and the backed types. The first has been reported in substantial numbers only from Ohalo II (*ca*. 25% of the microliths, excluding fragments) and Fazael X ('notable component' – Goring-Morris 1980b:188) though they were also found at Kebaran Urkan e-Rubb IIA (7.8% excluding fragments, Hovers and Marder 1991: Table 3). Still, Fazael X–XI and Ohalo II were viewed as belonging to a cultural entity unknown from other sites in the Jordan Valley. Thus, they have been incorporated in the recently defined 'Masraqan' by Goring-Morris (1995b) and the 'Late Ahmarian' by Kaufman (this volume).

Among the backed types, the micropoints and obliquely truncated backed bladelets are important (see above). At Fazael X, there are 1,038 microliths, of which 597 are complete. Of these, there are 12 obliquely truncated backed bladelets and seven micropoints (together 3%). At Ohalo II, out of 697 microliths (excluding fragments) there are three micropoints and five obliquely truncated backed bladelets (1%). Within the Kebaran, the two types form *ca*. 33% and 27% at Ein Gev I (layers 3, 4 respectively, Bar-Yosef 1970: Table 17), 37% at Urkan e-Rubb IIA (Hovers and Marder 1991), 42% at Wadi el-Hammeh 26 (Edwards *et al*.1996) and more than 50% at Fazael IIIA and IIIB (Bar-Yosef *et al*. 1974; Goring-

Table 18.5 Tool frequencies from Jordan Valley sites. All sites are Kebaran, excluding Ohalo II and Fazael X–XI (Early Epipalaeolithic/Masraqan). Sources: Fazael (FZ) sites: Goring-Morris 1980a; Ein Gev I (EG): Bar-Yosef 1970; Urkan e-Rubb IIA (UR IIA): Hovers and Marder 1991; Wadi el Hammeh 26 (WH 26): Edwards et al.*1996.*

	OH II	**Fz X**	**Fz XI**	**EG I (3)**	**EG I (4)**	**WH 26**	**UR IIA**	**Fz VII**	**Fz IIIB**	**Fz IIIA**
Endscraper	1.7	5.4	17.7	20.3	19.4	6.5	14.0	3.8	5.6	2.0
Carinated	–	8.7	1.6	8.1	6.8	–	1.4	–	1.7	0.4
Burin	4.3	9.5	6.5	13.7	12.1	5.5	3.6	6.2	5.4	5.3
Double	1.3	0.8	1.6	0.8	0.9	–	1.8	0.6	0.3	0.3
Blade	11.1	1.5	3.2	2.7	2.6	3.5	5.0	2.9	9.6	2.8
Truncation	0.9	1.3	–	2.1	0.7	–	0.9	2.1	5.1	0.5
Point	–	–	–	2.1	2.2	–	–	–	0.3	–
Microlith	63.0	57.0	56.5	34.6	39.8	79.0	61.3	73.7	60.3	80.5
Geometric	–	1.0	4.8	–	–	0.5	2.3	2.4	0.8	1.3
Awl	1.9	–	–	–	–	–	0.5	–	–	–
Notch	5.9	6.3	3.2	7.7	6.3	2.0	3.6	3.2	2.8	3.6
Microburin	–	–	–	–	–	–	–	0.3	1.1	0.3
Varia	2.2	8.6	4.8	8.0	9.3	2.0	5.9	4.7	6.8	33.1
N	2,596	1,822	62	865	1,079	194	222	339	353	3,108

Table 18.6 Microlith:scraper and microlith:scraper + burin ratios for Jordan Valley assemblages, and for various samples from Ohalo II.

Site	Microlith:Scraper	Microlith:Scraper + Burin
Ein Gev I/3	1.70	1.02
Ein Gev I/4	2.05	1.26
Fazael XI	3.19	2.33
Urkan e-Rubb IIA	4.38	3.48
Fazael X	10.56	4.10
Wadi Hammeh 26	12.70	5.48
Fazael IIIB	10.77	6.65
Fazael VII	19.39	7.37
Fazael IIIA	40.25	11.02
Ohalo II Locus 1	179.00	44.80
Ohalo II Locus 3	71.00	10.10
Ohalo II Locus 7	24.70	10.60
Ohalo II, total loci	84.00	15.30
Ohalo II surface	29.10	9.10

Morris 1980a). Another backed type, the proto-triangle, appears in small numbers and so far was reported from Ohalo II, Fazael X, Ein Gev I, and Fazael IIIA and IIIB.

The Ouchtata bladelets and the backed types (including obliquely truncated backed bladelets and proto-triangles) are present in both Kebaran and non-Kebaran Early Epipalaeolithic assemblages. Therefore, it seems that we are dealing with a quantitative issue, rather than a qualitative one. Ohalo II and Fazael X have a large number of finely retouched bladelets and have low numbers of 'true' Kebaran forms, while the Kebaran sites exhibit the opposite. The number of sites in the Jordan Valley is small, but as has been the case in other regions, when the number of studied sites increases, intermediate examples appear and complicate matters even more.

Four examples of inconsistent distinctions between Late Upper Palaeolithic and Early Epipalaeolithic assemblages represent research history and terminological changes. The first is Shunera XVI in the Negev where microliths form 56.5% of the tools (Goring-Morris 1987). Within this group, Ouchtata bladelets are dominant (42%) and there are no micropoints. Interestingly, three dates on eggshells average *ca*. 16,000 bp. The site was originally described as Terminal Upper Palaeolithic and later assigned to the Masraqan (Goring-Morris 1987, 1995b). A second Negev site, Azariq IV, has a large microlithic component (84.8%) with micropoints comprising 48.2% of the microliths (*ibid*.). And yet, it was presented as a Terminal Upper Palaeolithic assemblage together with Shunera XVI (Goring-Morris 1987). A third example is the site of WHS 784X in Wadi Hasa (Jordan). In a preliminary study based on debitage counts and microlith morphology the assemblage was tentatively described as Kebaran (Clark *et al.* 1987:47–52), while in a later study it was termed Late Ahmarian (Olszewski *et al*. 1990). However, it is important to remember that the three earlier assignments cited here were given within the research context used at the time. I, too, following a study of a preliminary small sample of tools, thought that the Ohalo II assemblage is Kebaran (Nadel and Hershkovitz 1991), and now believe this is not true. These examples illustrate the problematic aspects of cultural definitions based on relative frequencies of microlithic types.

Returning to the Jordan Valley, based on tool types in general and the microlithic varieties in particular, Fazael X and Ohalo II are not considered Kebaran (Goring-Morris 1995b; Kaufman this volume). However, the cultural labeling of flint assemblages according to typological criteria reaches a problematic crossroads when relative frequencies are incorporated. A clear-cut model of presence/absence of a chosen tool type(s) is too simplistic, though easy to use. However, when definitions are based on frequencies of certain types, there is always the problem of where to draw the boundary line within a continuum. The Kebaran complex includes Jordan Valley assemblages where micropoints and/or obliquely truncated backed bladelets comprise 50%, 37% and 27% of the microliths. This indeed reflects the dominance of the type, but also a wide range of quantitative variability: the first example is twice that of the latter. Where should one draw the line between the 1–2% and 50% presence within assemblages? Any line will be arbitrary and generate confusion in definitions and plenty of space for personal preferences. If we are still to use this criterion, a clear statement of minimum/maximum frequencies should be agreed upon. In a way, this is similar to the dilemma of defining certain microliths, where one type of retouch grades into another along the edge of the tool. Clearly, there are cases where one morphological type of tool grades into another with many intermediate specimens. In the case discussed here, maybe the boundary should be the ratio between Ouchtata:micropoints + obliquely truncated backed specimens. When the ratio is <1, we are dealing with Kebaran or Kebaran-related industries. When it is >1, we are facing the Masraqan, or Masraqan-related industries. This is not an exclusive criterion, and there are many differences even between assemblages distinguished in this way (*e.g*., among Masraqan cases or Kebaran examples). However, it could serve as another quantitative step towards clarifying cultural definitions.

According to the suggested ratio, the Ohalo II and Fazael X tool kits exhibit a quantitative composition different from Kebaran assemblages. However, they are also different from late Upper Palaeolithic assemblages. Goring-Morris views them as an early Epipalaeolithic entity, the Masraqan, equivalent of the Late Ahmarian (1995b and personal communication). If indeed a separation between the Upper and Epipalaeolithic time units is still valid in the southern Levant, then it is suggested here that the two sites are not late Upper Palaeolithic. Rather, as they do include types that become hallmarks in the Kebaran, they should be classified as Early Epipalaeolithic. The relevant types include the micropoints, obliquely truncated backed bladelets, proto-triangles and other pointed backed varieties (Nadel 1999). The proto-triangles are an important cultural marker, as they have been reported in small numbers from Mediterranean Kebaran sites/layers such as Hayonim Cave layer C (Bar-Yosef 1970:47, Figs. 21:27, 23:22, 24:2), Jiita II (Hours 1973: Fig. 2:18–19, Besançon *et al*. 1975–7: Fig. 6:1–4, 17), Nahal Oren pit G2-G3 (Bar-Yosef 1970:37, Fig. 15:34–41), Hadera I and II (Ronen and Kaufman 1976) and Nahal Hadera V (Saxon *et al*. 1978:259, Fig. 2:21–24).

As for the Ouchtata retouch, it should be stressed that at Urkan e-Rubb IIA, a radiometrically dated Kebaran site, this retouch was still in use. Thus, the Ouchtata presence at Ohalo II and Fazael X should not place them immediately in the Upper Palaeolithic or Late Ahmarian. The principles of 'new types as markers of new cultures' and 'old types can continue into the next culture' adopted here have been used many times in building cultural sequences in Levantine prehistory. Suffice it to mention

the appearance of new arrowhead types, even in small numbers, as a cause for ascribing an assemblage to a certain Neolithic phase. In addition, the continued production of lunates in the PPNA does not make the PPNA a late Natufian phase. In the same way, the use of Ouchtata retouch at Ohalo II and Fazael X should not automatically preclude an Epipalaeolithic label. It is the presence of new types that wins the day.

Today, typology cannot be the only criterion used for building a prehistoric cultural sequence for any given region. Technological aspects should be and indeed are incorporated, too. However, both Late Ahmarian and Early Epipalaeolithic assemblages are bladelet oriented, and as similar bladelet cores appear in both, distinction should be supported by comprehensive technological studies. Such an endeavour is beyond the scope of this typologically-oriented short paper. Indeed, some of the inter-assemblage differences are the result of raw material availability, site function, length and season of occupation, *etc*. (see papers in this volume). Nonetheless certain typological trends are illuminating.

Moving away from the chipped stone industries, the Ohalo II excavations provided a wealth of remains from *in situ* floors and hearths. There is ample evidence for year-round occupation, according to seasonal plants and animal food remains. These reflect fishing, hunting and gathering for subsistence. Tens of worked bone tools were recovered, as well as large numbers of *Dentalium* beads and several ground stone implements such as pestles and bowls. The variety of raw materials and implements indicate a wide range of on-site activities.

It is interesting that the low standardization of tool types, mostly expedient, fits well with a model proposed by Parry and Kelly (1987). Accordingly, nomads tend to produce highly efficient and multi-purpose tools (curated technology), while sedentary people tend to be less economic and use lower standard *ad hoc* tools (expedient technology). According to this model, the Ohalo II assemblage is closer to the sedentary cases than to the nomadic ones.

The period of *ca*. 20–15,000 bp provides a rich and varied array of flint assemblages from sites across the southern Levant. Within the Jordan Valley, Ohalo II and Wadi Hammeh 26 are radiometrically dated to exactly the same age (*ca*. 19,500 bp) and could be reached by walking within only several hours. However, their microlithic assemblages vary considerably. A similar picture is true for the Fazael sites, though here there could also be a chronological factor (Fazael X–XI older than the others?). It appears that even the available small number of sites in one restricted area reflect a multi-cultural organization on the landscape.

The period under discussion is the earliest where such a wide typological variability is clearly documented for a restricted geographical area and a relatively short length of time (*e.g*., Bar-Yosef 1970, 1991a; Besançon *et al*. 1975–77; Garrard *et al*. 1994; Goring-Morris 1987; Henry 1989a, 1995a; Hours 1973, 1974; Marks 1976b, 1981a). It should be pointed out that several dates have been regarded as too young. These include the Fazael X date (Goring-Morris in Housley 1994:59) and the Urkan e-Rubb IIA dates (Hovers and Marder 1991; Housley 1994:59), again considered by Goring-Morris to be too young. Indeed, it is possible that certain dates are erroneous. However, the relatively young but more-or-less contemporaneous dates of Ein Gev I, Urkan e-Rubb IIA, Fazael X, Shunera XVI and Ein Aqev East (through tentative correlation to the radiometrically dated Ein Aqev) might reflect more than just problematic dating results. As suggested by Hovers and Marder (1991), the typological variability during this period was wider, and lasted longer than previously thought. Thus, for several thousand years (*ca.* 20–15,000 bp) there existed contemporaneous technological traditions. In the Jordan Valley, these included adjacent Kebaran and Masraqan sites (both in the Fazael area and the Central Jordan Valley).

As a concluding remark, and as has been suggested previously by others, cultural definitions should be based on as wide as possible array of finds. If retouched flint tools are still the main axis of definition, a clear methodology of 'cutting a continuum' should be presented. As shown above, much of the confusion is due to this unclear procedure. It is suggested here that when a variety of new types and technologies appear, even in low frequencies, and even when some of the old ones are still in use, the assemblage should be assigned to the 'new' entity. Such was the method in many cases during the formation of the Palaeolithic-Neolithic sequence in the Levant. Accordingly, Ohalo II and similar sites should be viewed as early examples of the developing Epipalaeolithic cultural sphere. And if some of the 'ambiguous' radiometric dates are considered reliable, then the typological diversity reflects a complex cultural mosaic at the end and immediately after the Last Glacial Maximum in the southern Levant.

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19. The Conundrum of the Levantine Late Upper Palaeolithic and Early Epipalaeolithic: Perspectives from the Wadi al-Hasa, Jordan

Deborah I. Olszewski

Introduction

The Wadi al-Hasa region in west-central Jordan is a major drainage system trending from the east in the Transjordanian highlands to the west, where it enters the Wadi Araba just south of the Dead Sea. During the Pleistocene, the eastern Hasa system (near the Desert Highway) was characterized by an extensive spring-fed lake that through time diminished and became marshy (Schuldenrein 1998; Schuldenrein and Clark 1994). The course of the main drainage west of Lake Hasa is likely to have been characterized by a series of large ponds which formed immediately behind alluvial deposits at the confluence of the Wadi al-Hasa with many of its larger tributaries such as the Wadis Khasra and Ahmar (Olszewski *et al.* in press). Over time, these ponds also disappeared, to be replaced by localized marshes fed by freshwater springs. Ecologically, the Wadi al-Hasa thus offers a rare opportunity to examine Pleistocene adaptations centered on a special and highly hospitable context in the otherwise xeric inland Levant.

The Wadi al-Hasa Survey (WHS) was begun by MacDonald along the south bank of the drainage system in the late 1970s and early 1980s (MacDonald 1988; MacDonald *et al*. 1980, 1982, 1983). An additional intensive survey was conducted by Clark in the early 1990s on the northern bank (WHNBS, see Clark *et al*. 1992, 1994). More than 1,600 sites were recorded, of which 78 sites were identified as Upper Palaeolithic, Upper to Epipalaeolithic, and Epipalaeolithic. Sixty-two percent of this subset of sites are Upper Palaeolithic, 24% are Upper to Epipalaeolithic, and 14% are Epipalaeolithic. The sites include primarily *in situ* open-air sites in lake or pond marls, rockshelters, and sites on hillsides adjacent to the Pleistocene lake, as well as a few deflated sites on the plateau. The most striking feature, however, is that most sites (70%) are within 4 km of the Pleistocene Lake Hasa, especially at its northwestern end (Olszewski and Coinman 1998:188).

Clark initiated the Wadi Hasa Palaeolithic Project (WHPP) in the 1980s and early 1990s (Clark *et al*. 1987, 1988). Two Upper Palaeolithic, one Upper to Epipalaeolithic, and one Epipalaeolithic sites were among those tested (*idem*.; Coinman 1993b; Coinman *et al*. 1989; Olszewski *et al*. 1990, 1994). A second excavation project, the Eastern Hasa Late Pleistocene Project (EHLPP) began in the late 1990s to specifically examine Upper and Epipalaeolithic occurrences. The EHLPP tested seven sites (Coinman *et al*. 1999; Olszewski *et al*. 1998, in press). During the course of the EHLPP excavations, it became apparent through radiocarbon dating results that several of the sites categorized as late Upper Palaeolithic and those considered early Epipalaeolithic are archaeologically contemporary.[1] The implications of this are explored here.

The Sites

The occupation levels at three sites tested by the WHPP and the EHLPP yielded assemblages dating to the interval between about 23–19,000 bp. These sites are Ain al-Buhira (WHS 618), Yutil al-Hasa (WHS 784), and Tor Sageer (WHNBS 242) (Fig. 19.1).

Ain al-Buhira (or Ain al-Buhayra) is a large, open-air site situated along the ancient shoreline of Lake Hasa. The site is multi-component and the occupation of interest here is in the southern portion of the site, where a prominent spring tufa is a notable feature of the modern landscape. This area of the site (‘the spring area’) is well preserved and consists of inter-stratified lacustrine, spring, and marsh sediments (Coinman 1990, 1993b, this volume; Olszewski *et al*. 1998; Schuldenrein and Clark 1994). Tests in the spring area were initially conducted in 1984 by the WHPP (Clark *et al*. 1987, 1988); in 1997 the spring area tests were expanded by the EHLPP to obtain a greater horizontal exposure of the upper occupation zone (Olszewski *et al*. 1998). A total of 16 contiguous 1 m^2 units were excavated, representing the majority of the spring area available for subsurface excavations. The upper horizon (15–30 cm thick) represents an *in situ* deposit containing hearths and activity areas. Three

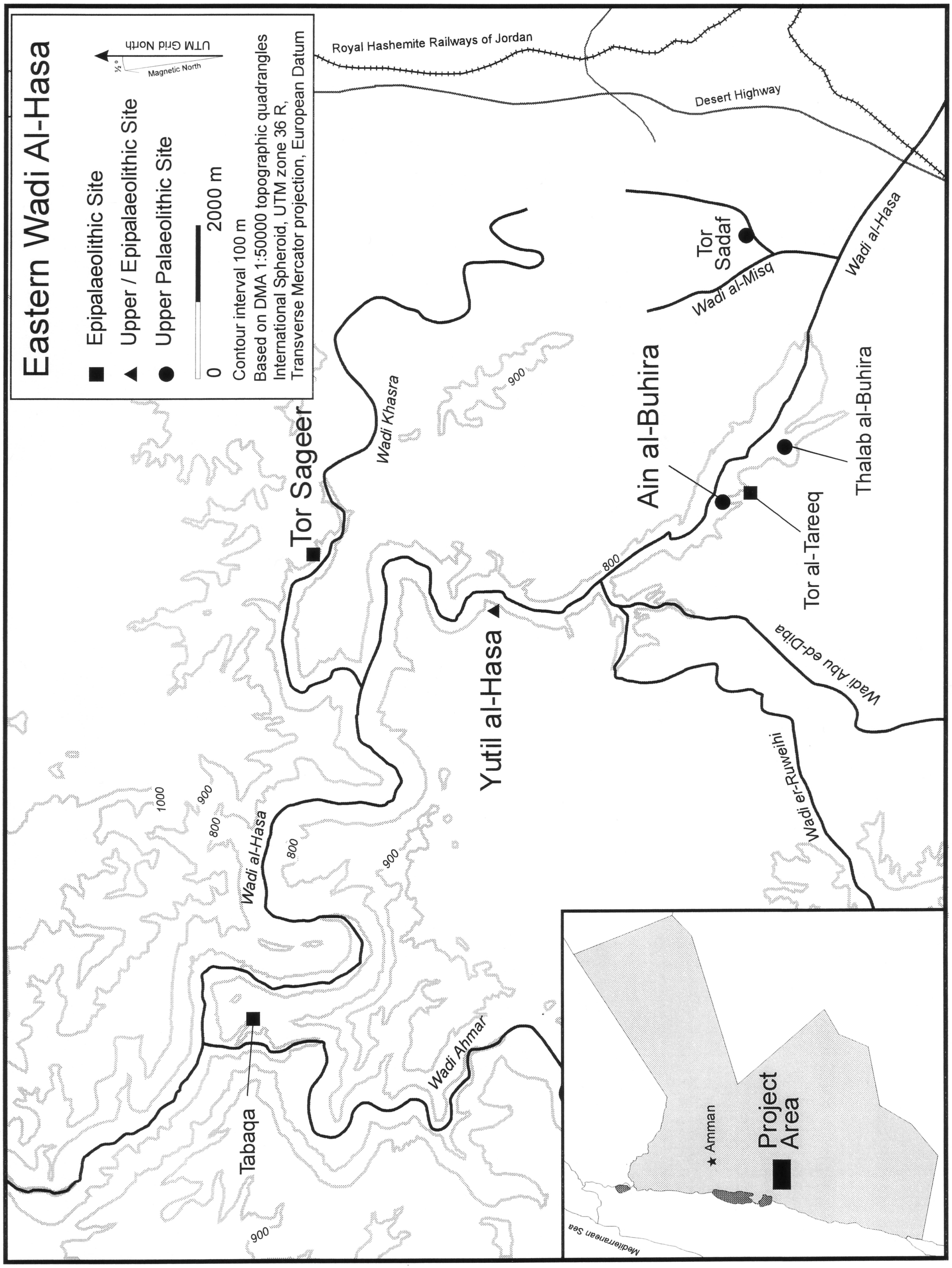

Fig. 19.1. Chronologically Contemporary Late Upper and Early Epipalaeolithic Sites in the Hasa.

Table 19.1. Radiocarbon Dates from Late Upper Palaeolithic and Early Epipalaeolithic Sites in the Wadi al-Hasa.

Site	Radiocarbon Date	Context	Material	Laboratory No.
Yutil al-Hasa Area A – upper	19,000±1,300	Unit A, hearth, Level 2A	charcoal	UA-4396
Ain al-Buhira spring area – upper	20,300±600	Test I, hearth, Level 2	charcoal	UA-4395
Tor Sageer – lower	20,330±60	Unit D3, Level 7	charcoal	Beta-129809
Ain al-Buhira spring area – upper	20,670±600	E68 N42, Level 6	organic sediment	Beta-118757
Tor Sageer – lower	20,840±340	Unit B3, hearth	charcoal	Beta-129811
Tor Sageer – lower	22,590±80	Unit B4, hearth	charcoal	Beta-129810
Yutil al-Hasa Area A – lower	22,790±80	Unit A, Level 19	charcoal	Beta-129813
Ain al-Buhira spring area – upper	23,500±270	Possible hearth; 15 cm below surface	organic sediment	Beta-56424

radiocarbon dates from the hearths in this horizon fall between 23,500 to 20,300 bp (Table 19.1). The earliest date corresponds roughly to the base of this occupation. Technologically, the lithic assemblage reflects a late phase in the Upper Palaeolithic (Coinman 1998a, 2000, this volume). Organic preservation is exceptionally good, with abundant faunal remains, and rarer items such as worked bone (Coinman 1997c), ostrich eggshell fragments, and dentalia. Red ochre is also present throughout the deposits.

Yutil al-Hasa is a moderate-sized, collapsed rockshelter situated about 4 km north (downstream) of Ain al-Buhira and Lake Hasa along the course of the Wadi al-Hasa channel. Deposits across the wadi from the site suggest a nearby spring and the sediments in the rockshelter areas are often magnesium-stained, indicating water seepage at the site. Yutil al-Hasa has at least three separate occupations, two of which are relevant here. The site was first tested in 1984 by the WHPP (Clark *et al*. 1987, 1988; Olszewski *et al*. 1990) and again in 1993 when additional areas of the site were excavated (Clark *et al*. 1994; Olszewski *et al*. 1994; Olszewski 1997). The EHLPP pursued further excavations in the three main occupation areas in 1998 (Coinman *et al*. 1999). Excavations were constrained by the presence of enormous roof-fall boulders, which limited the area available for testing. Area A had two contiguous 1 m^2 units, as did Area C. These units represent nearly the maximum area available for excavation in each of these portions of the site. Area A (70–80 cm thick; bedrock not reached) contains late Upper Palaeolithic lithic assemblages and includes at least one hearth. Radiocarbon dates from this area of the site range from about 22,790 to 19,000 bp (Table 19.1). A division between the upper and lower deposits in Area A was made on the basis of the radiometric dates and the presence of a small quantity of backed microliths in the upper deposits. The lower deposits of Area C (70 cm thick; bedrock not reached) have early Epipalaeolithic materials, but did not yield samples for dating. The lithic assemblage from the lower deposits in Area C, however, is very similar to the dated materials from Tor Sageer (described below). The upper deposits in Area C also yielded early Epipalaeolithic lithics, but these bear a greater resemblance to later phases of the early Epipalaeolithic that include narrow trapezes as a portion of the microlithic component and thus are not further considered below. Faunal preservation was variable in both areas, with some portions of the deposits yielding a moderate quantity of identifiable specimens.

The small rockshelter at *Tor Sageer* is in Wadi Khasra, a main north bank tributary of Wadi al-Hasa. The confluence of the wadis is about 3.5 km downstream from Yutil al-Hasa, while the site of Tor Sageer is approximately 2.5 km up the tributary wadi from the confluence. While this site is the farthest from Lake Hasa of those described here, based on the presence of marl deposits there would have been either a large, spring-fed pond or a marsh in the area of the confluence. The site was tested by the EHLPP in 1997–98, with the original test expanded during the second season to gain a larger horizontal exposure of the occupations (Coinman *et al*. 1999; Olszewski *et al*. 1998). Six contiguous 1 m^2 units were excavated of the approximately 15 m^2 that represent the rockshelter. The lower deposits (50 cm thick, reaching bedrock) of the site yielded early Epipalaeolithic lithics and at least two hearths or hearth areas. Radiocarbon dates from one hearth area and from near the top of the lower occupation zone range from 22,590 to 20,330 bp (Table 19.1). The upper deposits are also early Epipalaeolithic in age based on the lithic assemblage, but represent slightly later phases that include narrow geometrics (primarily trapezes) and are not further considered below. Faunal preservation is quite good throughout the entire sequence of deposits.

The Lithic Assemblages (Tables 19.2–5, Fig. 19.2)

The assemblages from the *Ain al-Buhira* spring area are classified as late Upper Palaeolithic, and more specifically, as Late Ahmarian, in technology and typology (Coinman 1993b, 1998a:49–50, 2000:147–152). Cores are primarily single platform types, although there are also examples of opposed platforms and change of orientation types. The remnant scars on the cores are frequently of blades or bladelets. Studies of core reduction strategies at the site suggest that core tablets are the main method of refurbishing the core platform, while platform blades or bladelets are used to create new orientations for

Table 19.2 Core Frequencies.

	Late Upper Palaeolithic			**Early Epipalaeolithic**	
CORES	Yutil al-Hasa Area A-lower	Yutil al-Hasa Area A-upper	Ain al-Buhira spring area*	Tor Sageer lower	Yutil al-Hasa Area C-lower
n=	(21)	(94)	(121)	(92)	(23)
Blade	9.5	8.5	present	4.3	–
Bladelet	19.0	13.8	present	23.9	52.2
Flake	19.0	23.4	present	27.2	17.4
Mixed	14.3	15.9	present	13.0	4.3
Fragment	38.1	38.3	present	31.5	26.1

*details not yet available

Table 19.3 Debitage Frequencies.

	Late Upper Palaeolithic			**Early Epipalaeolithic**	
DEBITAGE	Yutil al-Hasa Area A-lower	Yutil al-Hasa Area A-upper	Ain al-Buhira spring area	Tor Sageer lower	Yutil al-Hasa Area C-lower
n=	(1,948)	(5,794)	(15,670)	(7,003)	(5,559)
Blade	3.5	4.9	6.7	5.8	3.1
Bladelet	11.3	11.1	16.4	14.5	14.1
Flake	17.1	20.6	27.6	23.3	11.5
Small flake*	42.6	37.9	31.7	40.5	46.1
Core rejuvenation	1.0	1.0	0.9	1.5	1.2
Burin spall	0.9	0.9	0.4	0.2	0.1
Microburin	<0.1	0.1	–	0.7	0.9
	(IMbt = 1.1)	(IMbt = 1.9)		(IMbt = 10.7)	(IMbt = 14.4)
Debris	23.4	23.4	16.3	13.4	22.9

*Small flakes are less than 20 mm in size.

core platforms (Coinman 2000:151, this volume). Many of the cores appear to have originated from narrow, flat nodules with limestone cortex. The focus of core reduction is on the production of relatively small blanks, principally bladelets, although there are also examples of large blades and flakes.

Typologically, the Ain al-Buhira spring area assemblage is characterized by a majority of tools made on blade or bladelet blanks (Coinman 1993b:28). The smaller-sized tools include various examples of non-geometric microliths (retouched bladelets), the most notable of which are the finely retouched Ouchtata points and bladelets, which comprise more than 85% of this tool category. A few Dufour bladelets and backed microliths are present, but these types are extremely rare (Coinman personal communication). As in many Upper Palaeolithic assemblages, endscrapers and burins are a moderate component of the tool assemblage. There are also retouched pieces, and small frequencies of borers (perforators), truncations, and notches/denticulates.

Late Upper Palaeolithic assemblages from *Yutil al-Hasa Area A* can be divided into an upper and lower set of occupations, which are separated on the basis of radiometric dates (see Table 19.1), slight differences in non-geometric tool types over time, and shifts in raw material preferences. Technologically and typologically, both are Late Ahmarian in character (Coinman *et al*. 1999:19–20; Olszewski 1997:173–175; Olszewski *et al*. 1990). Final core morphology is oriented towards the production of blades and bladelets, with greater numbers of bladelet cores. There is also a moderate frequency of flake cores. Cortex on cores, when present, is almost always a limestone cortex characteristic of nodular chert. Core tablets and platform blades and bladelets are present and suggest core reduction patterns similar to those from the spring area at Ain al-Buhira. Blade and bladelet debitage is somewhat less frequent than at Ain al-Buhira. An extremely low incidence of regular microburins is present in both the lower and upper occupations (Table 19.3).

The tools in Yutil al-Hasa Area A are dominated by non-geometric microliths, although not quite to the extent as at Ain al-Buhira. The upper occupation tends to have more endscrapers and burins than the lower habitation zone and a slightly reduced frequency of non-geometric microliths. Other tools are retouched pieces, notches/denticulates, truncations, and sidescrapers (special tools). Non-geometrics include high frequencies of Ouchtata points and bladelets in both occupations, as well as a low frequency of Dufour bladelets. The main typological difference between the lower and upper occupations is

Table 19.4 Tool Class Frequencies.

TOOLS	Late Upper Palaeolithic Yutil al-Hasa Area A-lower	Late Upper Palaeolithic Yutil al-Hasa Area A-upper	Late Upper Palaeolithic Ain al-Buhira spring area	Early Epipalaeolithic Tor Sageer lower	Early Epipalaeolithic Yutil al-Hasa Area C-lower
n=	(90)	(360)	(633)	(433)	(316)
Endscraper	4.4	7.2	10.4	9.7	2.5
Burin	4.4	7.5	4.6	2.1	0.9
Borer	–	–	0.3	0.2	0.3
Backed Piece	–	–	–	1.4	–
Truncation	5.5	1.1	1.6	3.2	1.9
Notch/Denticulate	10.0	10.6	0.8	7.6	5.4
Retouched Piece	17.9	23.9	11.4	12.2	12.0
Special Tool	3.3	2.5	–	0.9	0.3
Multiple Tool	–	0.5	0.8	0.2	–
Non-geometric Microlith	54.4	46.4	68.4	59.8	75.6
Geometric Microlith	–	0.3	–	1.4	0.9
Varia	–	–	1.7	1.2	–

Table 19.5 Non-geometric Microlith Type Frequencies.

TYPE	Late Upper Palaeolithic Yutil al-Hasa Area A-lower	Late Upper Palaeolithic Yutil al-Hasa Area A-upper	Late Upper Palaeolithic Ain al-Buhira spring area*	Early Epipalaeolithic Tor Sageer lower	Early Epipalaeolithic Yutil al-Hasa Area C-lower
n=	(49)	(167)	(433)	(259)	(239)
Ouchtata	77.5	49.1	85.9	9.3	7.1
Dufour	4.1	4.2	present	4.6	5.8
Qalkhan Point	–	–	–	1.5	0.4
La Mouillah Point	–	–	–	2.7	3.3
Backed and Truncated	–	4.2	?	15.1	16.3
Truncated	–	1.8	?	4.2	8.0
Curved	–	2.4	?	10.4	15.1
Double Curved	–	–	?	1.2	1.7
Other	6.1	13.2	present	33.2	23.8
Fragment	12.2	25.1	present	17.8	18.4

*most details not yet available

that a small number of backed microliths appear in the upper deposits.[2]

The lower deposits of *Yutil al-Hasa Area C* are technologically and typologically classified as early Epipalaeolithic (Coinman *et al*. 1999:20–21; Olszewski 1997:175–176; Olszewski *et al*. 1994). A very high frequency of bladelet cores is present, as well as moderate numbers of flake cores. Although the core sample is small, it is interesting that no blade cores were recovered, especially as blades are present in the debitage. Almost all the cores with preserved cortex are nodular. As during the late Upper Palaeolithic occupations at the Ain al-Buhira spring area and Area A at Yutil al-Hasa, the main focus of core reduction is the production of bladelets. Core tablets and platform blades and bladelets are used to refurbish cores. Bladelet debitage is similar in frequency to that recovered from Ain al-Buhira. A low incidence of regular microburins is present (Table 19.3).

The tools from the lower deposits at Yutil al-Hasa Area C are dominated by non-geometric microliths. These include a modest number of Ouchtata points and bladelets, as well as Dufour bladelets. The main forms, however, are backed microliths such as curved, and backed and truncated varieties. Many of the backed microliths have remnant microburin scars attesting to the use of this technique to snap bladelets prior to their modification into tools. A few Qalkhan and La Mouillah points are also present. Other tools include retouched pieces, notches/denticulates, and rare endscrapers, burins, borers, truncations, sidescrapers (special tools), and geometric microliths (a narrow trapeze and a couple of triangles).

Lithic assemblages from the lower deposits at *Tor Sageer* are also classified as early Epipalaeolithic in technology and typology (Coinman *et al*. 1999:16–19; Olszewski *et al*. 1998:59–61). There is a low frequency of blade cores, and bladelet cores occur in similar

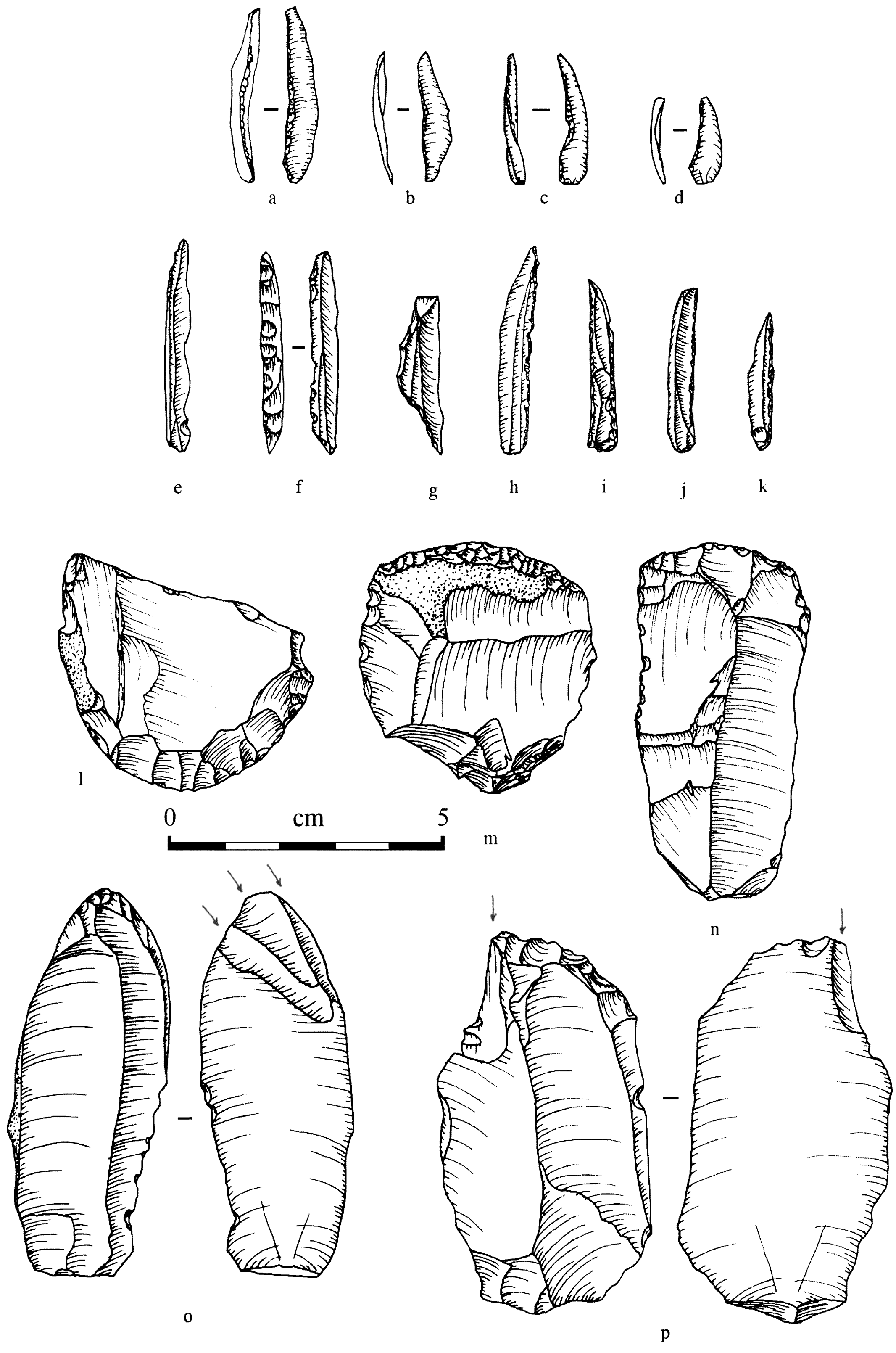

Fig. 19.2 Examples of late Upper and Early Epipalaeolithic Tools. a-d, Dufour bladelets; e, curved backed microlith; f, backed and truncated bladelet; g, Qalkhan point; h-k, Ouchtata points and bladelets; l-m, flake endscrapers; n, blade endscraper; o-p, burins. (Ain al-Buhira: h; Yutil al-Hasa Area A: d, k, m, o-p; Yutil al-Hasa Area C: c, e; Tor Sageer: a-b, f-g, i-j, l, n).

frequencies to the flake cores. As at the other sites, the majority of cores are nodular with limestone cortex. Most are single platform types and the majority exhibit bladelet removals. Cores are refashioned using core tablets and platform blades and bladelets. Bladelets are the main objective of the reduction sequence; their frequency is comparable to both Ain al-Buhira and Yutil al-Hasa Area C-lower. Blade debitage is slightly more frequent than at Yutil al-Hasa, but similar to Ain al-Buhira. The incidence of regular microburins is analogous to that from Yutil al-Hasa (Table 19.3).

The Tor Sageer lower tool assemblage is characterized by a high percentage of non-geometric microliths. In this regard, it is similar to both Yutil al-Hasa Area C-lower and Ain al-Buhira. The composition of the non-geometrics, however, is weighted toward backed microliths, such as curved, and backed and truncated types. This is akin to Yutil al-Hasa Area C-lower. Ouchtata points and bladelets, as well as Dufour bladelets, are also notable components, but the Ouchtata types are far less frequent than at Ain al-Buhira. As at Yutil al-Hasa Area C-lower, a few Qalkhan and La Mouillah points are present. Backed microliths often have remnant microburin scars. The larger tool component includes retouched pieces, end-scrapers, notches/denticulates, and rarer examples of burins, borers, backed pieces, truncations, sidescrapers (special tools), and geometric microliths (mainly narrow trapezes and bi-truncated bladelets).

The Ecological Context[3]

Geoarchaeological research in the Hasa region, as well as specialized studies of fauna, pollen, and phytoliths, have added considerably to a better understanding of the ecological context of the Hasa sites. As described elsewhere, the Wadi al-Hasa drainage system is the only perennial watercourse draining the central Jordanian Plateau (Schuldenrein and Clark 1994:34–36; Schuldenrein 1998:205–207). The Hasa drainage encompasses 1,740 km^2 and comprises two sub-basins, an 'upper' Hasa and a 'lower' Hasa. These are composed of fluvial sequences in the lower Hasa and lacustrine sequences in the upper Hasa, with the two divided by the Hasa fault (Schuldenrein 1998:207, 224). The entire region, however, is actually typified by dozens of faults, both minor and major (Tarawneh 1996). The use of the term Hasa fault in earlier reports (*e.g.*, Donahue and Beynon 1988:27–29) refers to a northwest to southeast trending major fault which lies mainly just north of the Wadi al-Hasa and likely is responsible for the development of the Wadi al-Hasa drainage in its present topographic position. Minor fault lines associated with the Hasa fault or the Hasa fault itself may divide the lower and upper Hasa, or possibly serve as breach points for the Pleistocene Lake Hasa. The section of the Hasa fault that intersects the Wadi al-Hasa drainage closest to the eastern lake runs on a line through the Hasa marls at the confluence of the Wadis al-Hasa and Khasra and ends about 1 km north of the site of Yutil al-Hasa. Given that this fault line runs through Hasa marls with no dislocation of the marls, it appears that this section of the fault has not been active since the formation of the large pond at this confluence. It is more likely that a minor fault immediately downstream of the confluence of the Wadis al-Hasa and er-Ruweihi or headward erosion were responsible for the breaching of Lake Hasa. Tributary wadis to the Wadi al-Hasa are most prominent in the eastern (or upper) Hasa sub-basin (see Fig. 19.1).

The Hasa marls, which represent the remnants of the Pleistocene lake's bottom, are found most extensively in the open, eastern Hasa just west of the Desert Highway. These marls are also identified at the confluence of Wadis er-Ruweihi and Abu ad-Diba, which join a short distance before Wadi er-Ruweihi (a primary tributary) enters Wadi al-Hasa. The geological map for the area also identifies Hasa marls at several locations in the main Wadi al-Hasa drainage. The location farthest downstream of these marls is about 2.25 km downstream from the confluence with the Wadi 'Ali (or 3.25 km upstream from where the King's Highway crosses the Wadi al-Hasa [Tarawneh 1996]). Discussions with geologists[4] working in the region suggest that the Hasa drainage may actually have been characterized by a spatially duscrete series of Pleistocene ponds downstream of the Pleistocene Lake Hasa. This lake was present in the eastern Hasa, and perhaps would have been dammed by sediments near the confluence of Wadis er-Ruweihi and al-Hasa. The large ponds could have been present at each major confluence, for example, where Wadis Khasra, Ahmar, and 'Ali join with Wadi al-Hasa. All of these ponds would have been fed by freshwater springs, as well as seasonal rainstorms and runoff.

The large lake (a minimum surface area of 48 km^2) in the eastern portion of the Hasa is thought to have been near peak levels in the interval between *ca*. 25–20,000 bp (Schuldenrein and Clark 1994:46; Schuldenrein 1998:219). Worldwide climatic changes associated with the approach of the Last Glacial Maximum, however, probably resulted in lake shrinkage and possibly the disappearance of the downstream ponds. These would have been replaced by localized marshes and stream edge microenvironments by about 17,000 bp.

Of the sites that have overlapping chronological placement in the late Upper Palaeolithic to early Epipalaeolithic, the most extensively reported geoarchaeological work to date has been at *Ain al-Buhira* and in its immediate environs. The spring area of the site is composed of narrow lenses of clays and organic silts with chemical precipitates; these sediments are inter-stratified with the remnant spring tufa mound and contain the occupations dating to the late Upper Palaeolithic (Schuldenrein and Clark 1994:39; Schuldenrein 1998: 209). The tufa rests atop eroded marls, and reflects spring discharge into the lake. Its source appears to be an aquifer

at a facies break in the bedrock limestone (Olszewski *et al*. 1998:70). The heavy fraction from flotation samples has yielded abundant microscopic freshwater snails, which have not yet been analyzed in detail.

Phytolith studies[5] and preliminary pollen analyses suggest an open environment. Earlier pollen analysis showed high frequencies of Chenopodiaceae and *Artemesia* (Clark *et al*. 1987:43–44). There are numerous wood phytoliths from herbaceous plants or trees, and interestingly, far fewer examples of phytoliths from grasses, which might be expected to be a major component of an open environment. Grass phytoliths include representative elements from C_3 Pooid grasses that might be indicative of a cooler, moister regime. Of additional interest is the lack of phytoliths from sedges and reeds in the spring area of the site, although the underlying marl deposits, which predate the late Upper Palaeolithic occupation, do contain pollen from sedges.

The 1984 faunal assemblage from Ain al-Buhira contains primarily mammals; there are no fish or waterfowl. The mammalian fauna are principally equids, which are well represented by teeth; there are also *Bos* remains, an ovicaprid, and tortoise (Clark *et al*. 1987:43; Coinman 1993b:19, 2000:151). In addition to teeth, bone elements include long bone shafts, articular ends, and bones of the foot. A probable gazelle horn core was recovered in 1997, but current evidence suggests that gazelle were not targeted for exploitation to any great extent (Coinman 2000:151).

Geoarchaeological work at *Yutil al-Hasa* Areas A and C and in the immediate vicinity of the site helps document the microenvironment in this portion of the wadi, some 4 km to the north-northwest of Ain al-Buhira and the large lake in the eastern Hasa. After the confluence of Wadis al-Hasa and er-Ruweihi, Wadi al-Hasa narrows considerably, and this is its character where Yutil al-Hasa is situated. Across the wadi from the site is a 16 m thick marl deposit which is capped by a 3 m thick tufaceous spring deposit. The spring deposit occurs at approximately the same elevation as the late Upper Palaeolithic occupation in Area A; this tufaceous deposit is a close correlate to the spring tufa at Ain al-Buhira (Schuldenrein 1998: 211). The early Epipalaeolithic occupation in Area C contains sediments that are heavily stained with iron and sulphur streaks that suggest water flow, perhaps correlated with spring activity at the rockshelter itself (Schuldenrein 1998:211). There are colluvial episodes registered within the Area C sediments, particularly in the upper deposits that postdate the occupations under discussion here.

Preliminary pollen results suggest an open, steppic environment for both Areas A and C.[6] The phytoliths from Area A-lower and Area C-lower are similar to Ain al-Buhira in containing abundant woody specimens from herbaceous plants and trees. Grass phytoliths are present in both Area C-lower and Area A-lower, and as at Ain al-Buhira, neither of these occupations has sedge or reed phytoliths. The woody phytoliths from Area C-lower are interesting in that they include a significant quantity of phytoliths from leaves, which may indicate seasonality. If so, this would correspond with early Epipalaeolithic occupations occurring sometime in the interval from spring through fall, when deciduous plants are in foliage. As none of these types of phytoliths are present in the woody phytoliths from Area A-lower, the late Upper Palaeolithic occupation there possibly occurred during a different season of the year.

Fauna from the 1984 excavations in Area A and the 1993 tests in Area C at Yutil al-Hasa document the same range of species in both occupations. The 1984 Area A fauna is from the upper deposit. It includes gazelle, which is the most numerous, then equid, plus a few *Bos* remains, an ovicaprid, and tortoise (Clark *et al*. 1987:52; Olszewski *et al*. 1990:45). The gazelle elements are primarily long bones and bones of the foot, but include also a horn core. The equids have a similar representation, while the *Bos* remains are phalanges. Preliminary observations on the fauna from the 1998 season include an additional gazelle horn core and an equid distal phalange (Leslie Hartzell personal communication). The early Epipalaeolithic deposit in Area C (lower and upper deposits) contains mostly small artiodactyl or gazelle elements, primarily teeth, and a few long bone and foot bone elements. There are a couple of equid teeth, a *Bos* tooth, and tortoise remains as well (Olszewski *et al*. 1994:134). Much of the bone from Area C in 1993 was highly fragmented and could not be further identified.

No geoarchaeological work has been undertaken at the small rockshelter at *Tor Sageer*, although limited observations are available for the extensive marl deposits at the confluence of the Wadis al-Hasa and Khasra. The marls at the confluence are a 30 m high terrace representative of ponding environments that are likely to occur at primary confluences (Olszewski *et al*. 1998:68). There are no marl deposits in the immediate vicinity of the site.

The preliminary pollen spectrum for Tor Sageer indicates an open, steppic environment. There are also abundant riparian elements. Phytoliths include significant numbers of woody herbaceous plants and trees, some of which are from leaves and might suggest seasonal use of the site during the spring to fall. Both of the hearths in the lower deposit at the site contain dendritic forms that might indicate the use of grass seeds, which could, in turn, suggest a spring occupation when grasses are in flower and seed. The grass phytoliths include representatives of both C_3 Pooid and C_4 Panicoid grasses, perhaps indicating an ecotonal zone with both moister and drier elements. The abundant grass phytoliths could be derived from fuel and bedding. Unlike the other occupations discussed here, the Tor Sageer phytoliths include numerous examples of sedges and reeds, which reflect the nearby proximity of standing pools of water.

Fauna from the 1997–98 excavations at Tor Sageer are currently being studied. Personal observation during the field seasons indicates that there are both large (*Bos*/

equid size), as well as medium mammal (gazelle/ovicaprid size) elements. Preliminary observations during the washing of the faunal remains show that the fauna includes a gazelle horn core, several distal phalanges of an equid, as well as bones of large-sized bird(s) and tortoise carapace fragments (Leslie Hartzell personal communication). Other specimens include teeth, a small half-mandible, articular ends of long bones, phalanges and other bones of the foot.

Discussion

The apparent archaeological contemporaneity, based on radiometric dates, of the late Upper Palaeolithic and some of the early Epipalaeolithic occupations in the Hasa region raises the interesting conundrum of how these configurations might best be interpreted based on the available evidence. Previous Levantine research has suggested that the overall similarity of adaptations that have been divided into late Upper Palaeolithic and early Epipalaeolithic based on lithic assemblages argues for classifying all pre-late Epipalaeolithic (pre-Natufian) occurrences as Upper Palaeolithic (*e.g.*, Gilead 1989:239–241). On the other hand, many researchers continue to use the terminology of late Upper Palaeolithic and early Epipalaeolithic, recognizing that such terminology documents interesting changes in microlithic tools, for example, the appearance of backed microliths, even if an understanding of what this signifies remains poorly understood chronologically and in terms of cultural material change (*e.g.*, Goring-Morris 1989b:12, 1995b: 146).

Syntheses such as those by Gilead (1989) and Goring-Morris (1987, 1995b) have the advantage of examining these issues over a broad geographical area and over a wide range of time. This type of approach allows for the delineation of major interpretive problems. Because of their broad scope, however, they do not offer the opportunity to examine the problems at the small scale often necessary for the resolution or refinement of the issues, such as can be found with a set of sites, *e.g.*, those in the Hasa, that are well-controlled chronologically, spatially proximate, in a similar ecological context, and which have yielded not only lithic assemblages, but also well-preserved fauna and phytoliths. The 'meaning' of late Upper Palaeolithic and early Epipalaeolithic adaptations is best sought, as Copeland (1997:189) recently advocated, with an environmental or comparative approach (see also Bar-Matthews and Ayalon this volume), and that is the intent of this discussion.

Hypotheses common to archaeological research approaches in the region and elsewhere include three basic formulations. The first is that the lithic assemblages at these sites reflect functional differences, perhaps tied to activities that characterize different seasons during the year. Although the areas tested at the Hasa sites for each occupation vary in terms of site coverage, the facts that the tool class composition is similar in relative frequencies from site to site (an expectation of the Gilead 1989 model), and hearth areas were found in nearly all cases, suggest that size of the exposed areas did not influence the representativeness of tool-based site activities. Types within the microlithic tool class, however, do vary and this may be tied to specific functional differences between the sites. A second hypothesis is that the differences may be explicable in terms of temporal change in assemblages. Finally, these site occupations might reflect use of the Hasa region by different groups of people.

Of the three hypotheses, the most robust in terms of potential test implications is Hypothesis 1 (activity differences). Several lines of archaeological, geoarchaeological, and environmental evidence can be examined for features of lithic technology and typology, landscape contexts, seasonality indicators, local microenvironments, fauna, and site situations that factor into the types of activities in which prehistoric groups were engaged. In the case of Hypothesis 2 (temporal difference), only radiocarbon dating can be used to formulate a test implication that is directly related to the hypothesis. As noted by many researchers (*e.g.*, papers in Bar-Yosef and Kra 1994), radiocarbon dating does not provide resolution that is tight enough to assess changes over small increments of time, even in the range of a few thousand years. Finally, for Hypothesis 3 (different cultural groups), a situation comparable to that for testing Hypothesis 2 exists. In this case, the only direct line of evidence available is attributes of lithic technology and typology.

Available pollen analyses indicate that the Hasa region was characterized by an open vegetation, with grasses, *Artemesia*, and chenopods. The drainages likely had trees, such as oak and possibly juniper/cedar. Other species would have included willow, pistachio, and carob. Of the sites discussed here, riparian species are especially notable in the pollen from Tor Sageer.

Geoarchaeological reconstructions of the landscape of the Hasa indicate that several topographic situations characterized the Wadi al-Hasa drainage system. The eastern basin was a relatively open area with a large lake stretching toward the southeast. Immediately northwest of the confluence of Wadis al-Hasa and er-Ruweihi, the wadi is quite narrow, a situation also typical for most of the tributary wadis except for Wadis er-Ruweihi and Abu ad-Diba. Large ponds likely filled some of the narrower portions of the wadis. It might be expected that these contexts provided different opportunities for prehistoric activities, as potentially would open-air as opposed to rockshelter locales. Ain al-Buhira is an example of an open-air site near the large lake in the open eastern basin. Yutil al-Hasa and Tor Sageer are rockshelters in narrow, relatively closed-in segments of the wadis (Fig. 19.1).

When the lithic assemblages from these sites are compared, it is immediately apparent that there are similarities in technology, typology, and overall assemblage composition. An emphasis on the manufacture of

bladelets and blades is consistently present across all five occupations at the three sites. Technologically, nodular cores are refurbished using the strategy of core tablets and platform blades and bladelets. Bladelet blanks are selected for microliths, while larger tools are manufactured on both blades and flakes. All except Ain al-Buhira have examples of regular microburins. Tool assemblages from all five occupations exhibit high frequencies of non-geometric microliths. All occupations have Ouchtata points and bladelets, as well as low frequencies of Dufour bladelets, in addition to various larger tools such as endscrapers, burins, and so forth. Such shared technological and typological attributes do not lend support to the hypothesis of different cultural groups.

Although homogeneous on the level of broad techno-typological attributes, there is some variability between the tool classes of the occupations at these sites, probably reflecting activity emphases. For example, in a recent study of microliths and other components of lithic assemblages from sites of the late Upper Palaeolithic and early Epipalaeolithic in Jordan, al-Nahar (2000:93–95) found that the occupations at these Hasa sites cluster (along with other sites) into several groups. These were interpreted as meat processing and butchering sites (Cluster 1 containing Ain al-Buhira and Yutil al-Hasa Area A), hunting and manufacturing of hunting gear sites (Cluster 2 with Yutil al-Hasa Area C), and multi-purpose activity sites (Cluster 3 including Tor Sageer) (al-Nahar 2000:112–115).

The Cluster 1 sites are characterized by high frequencies of Ouchtata bladelets (including Ouchtata points) and a lower artefact density. Cluster 2, on the other hand, has a diverse array of backed microlith types, high frequencies of curved backed microliths including those with microburin scars, a modest representation of Ouchtata bladelets, higher artefact densities, and a greater emphasis on bladelet production. Finally, Cluster 3 comprises sites with the highest frequency of pointed backed microliths and Qalkhan points, moderate numbers of Ouchtata bladelets, and artefact densities similar to Cluster 1 sites.

The limited activity set that characterizes Yutil al-Hasa Area C, particularly in contrast to the assemblages from Area A, supports the previous observations of Olszewski (1997:173–176). Al-Nahar's explanation of the spring area assemblage from Ain al-Buhira, however, is much narrower than Coinman's interpretation of the overall site function. Coinman (1993b:33; Olszewski *et al*. 1998:64–66) has described the spring area as containing evidence that reflect generalized basecamp activities, such as core reduction in proximity to at least one hearth area and spatially discrete concentrations of Ouchtata points and fragments of Ouchtata points, as well as endscrapers. The density of animal bone at the site, moreover, indicates that butchering and processing were also conducted here (Coinman 2000:151–152).

Site occupations (Yutil al-Hasa Area C-lower and Tor Sageer-lower) with a modest representation of regular microburins also have significant frequencies of backed microliths, many of which exhibit remnant microburin scars. This technology/typology association is geographically widespread in Jordan in this early range of time, being found also in southern Jordan (Henry 1995c: 225) and in the Azraq Basin (Garrard *et al*. 1988a:325–326). Sites with little or no representation of the microburin technique (*e.g*., Ain al-Buhira spring area and Yutil al-Hasa Area A lower and upper) are characterized instead by Ouchtata points and bladelets, a configuration that includes sites in the Azraq Basin (Garrard *et al*. 1987:18), the Negev (Ferring 1977:100–102; Goring-Morris 1987: 84); and the Jordan Valley (Goring-Morris 1980b:186–188; Nadel this volume).

This contrast of sites with incidental or no microburin technique/backed microliths and those that have this set of lithic artefacts is significant because this distinction serves as a primary lithic definition of what is considered late Upper Palaeolithic as opposed to early Epipalaeolithic between 23–19,000 bp, particularly in Jordan.[7] Since research proclivity is to assign assemblages to different traditions based on this definition, it essentially excludes activity or seasonal activity as possible explanations for the lithic differences. When the two distinct settings – open lakeside and narrow wadi – are correlated with faunal and phytolith information, however, an interesting pattern emerges. The open lakeside site at Ain al-Buhira is characterized almost exclusively by equids, along with some *Bos*. Some of the equid bone is tentatively identified as the wild Asiatic half-ass (*Equus hemionus*) (Clark *et al*. 1988:242).[8] Behaviorally, this equid in central Asia was known to seasonally migrate in large groups for hundreds of km wintering in the desert areas (Yagodin 1998:221). It is possible that the equids at Ain al-Buhira were seasonal visitors to the Hasa.

In contrast, the fauna from the narrow wadi rockshelter at Yutil al-Hasa (Areas A and C) is dominated by gazelle (one horn core is identified as *Gazella subgutturosa*), but also has a few *Bos* bones and a modest representation of equid remains. The specimens identified to species in Area A are European wild ass (*Equus hydruntinus*) (Clark *et al*. 1988:251; Olszewski *et al*. 1994:134). The behavioral patterns of *Gazella subgutturosa*, a steppic species, are not well-known.[9] These gazelle might, however, be expected to be present in wadi bottoms during the summer and to congregate in areas of denser vegetation during the fall-spring – areas such as those with springs and ponds – and there is some data to suggest that groups were seasonally migratory between areas of lower rainfall in the winter and higher rainfall/more available surface water in the spring to fall (Legge and Rowley-Conwy 2000:440), at least over short distances (Martin 1998:168). Given the variety of microhabitats in the Hasa, these gazelle might be expected to be nearly year-round occupants.

In addition, the phytolith data from the three occupations typified by high frequencies of Ouchtata points and bladelets (Ain al-Buhira, Yutil al-Hasa Area A upper

and lower) include specimens from woody plants, but with little to no representation of phytoliths from the leaves of woody plants. Sites with systematic use of the microburin technique and backed microliths (Yutil al-Hasa Area C-lower and Tor Sageer-lower) also have woody plant phytoliths, including moderate quantities of woody plant leaf phytoliths. This suggests that the sites might be occupied during different seasons of the year - Ain al-Buhira and Yutil al-Hasa Area A during the winter-early spring, and Yutil al-Hasa Area C and Tor Sageer during the spring-fall.

In this scenario, Ain al-Buhira appears to be a winter-early spring site where equids were hunted almost to the exclusion of other mammals. Hunters here took advantage of hunting *E. hemionus* when it was available. This did not preclude their hunting of other species of equids (*E. hydruntinus*) and gazelle during the same season, but at different locales in the Hasa like the narrow wadis around Yutil al-Hasa Area A. During the spring-fall seasons, the narrow wadi sites (Yutil al-Hasa Area C and Tor Sageer) also saw hunting of gazelle and other species of equids - animals that had a year-round presence in the Hasa. In this situation, the differences between microlith type emphases at the sites should relate to seasonally dependant activities. Hypothetically speaking, backed microliths might be used in tools primarily for processing plants available in the spring to fall period or large bird hunting (*e.g.*, Tor Sageer). Items such as Ouchtata bladelets could be either components of ungulate hunting implements or of meat processing implements. The consistent presence of Ouchtata bladelets across all five occupations, but with differing relative frequencies would thus be a reflection of the intensity of ungulate hunting or meat processing activities at these sites.

The lack of precision in identifying small segments of time by radiocarbon dating, however, leaves open the possibility that the differences between the Hasa lithic assemblages *ca*. 23–19,000 bp is due to the rapid replacement of microlith types in Jordan once microburin technology was systematically practiced. Site stratigraphies in the Hasa do not, unfortunately, help to clarify this problem. Sites or areas of sites with assemblages classified as early Epipalaeolithic are neither overlain nor underlain by late Upper Palaeolithic assemblages. The seasonality information discussed above would still pertain, but would also reflect changes over time – in this case, in settlement patterns. In this scenario, late Upper Palaeolithic sites (Ain al-Buhira and Yutil al-Hasa Area A) are winter-early spring occupations, while early Epipalaeolithic sites (Yutil al-Hasa Area C and Tor Sageer) are spring-fall in timing.

The conundrum of the late Upper Palaeolithic and the early Epipalaeolithic in the Hasa and elsewhere in the Levant remains far from solved. The exploration of aspects of seasonality, which has shown promise, will continue. As more analyses of pollen and faunal assemblages are completed for the Hasa sites, these data will help refine and modify the interpretations presented here. Additionally, forthcoming research on sites of the Azraq Basin (Garrard in press) from the late Upper Palaeolithic (Azraq 17) and the early Epipalaeolithic (Uwaynid 14, Uwaynid 18, and Jilat 6) will make available a data set from another inland Levantine lake/marsh and wadi system context. These will serve as an invaluable comparison with the information from the Hasa region and further help to elucidate late Pleistocene adaptations in the eastern Levant.

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Notes

1 The site of Tor al-Tareeq (WHS 1065) also has an early Epipalaeolithic occupation (Clark *et al*. 1988, 1997; Neeley *et al*. 1998, 2000). I do not use information from this site here because the radiometric dates from Tor al-Tareeq, which fall between 16,500–15,500 bp, are several thousand years later than the sites considered. The microlith assemblage also has a closer resemblance to the latter portion of the early Epipalaeolithic, such as is found at Yutil al-Hasa Area C-upper and Tor Sageer-upper, neither of which are discussed here.

2 The same phenomenon of a small number of backed microliths in upper compared to lower deposits is also found in Area B at Yutil al-Hasa (not discussed here).

3 Pollen research is ongoing for Ain al-Buhira, Yutil al-Hasa, and Tor Sageer (Suzanne Fish, Arizona State Museum, Tucson, AZ). Results reported here are preliminary. Faunal assemblages have been studied from the 1984 excavations at Ain al-Buhira and Yutil al-Hasa (Andrew Garrard, Institute of Archaeology, UCL London), as well as the 1993 season at Yutil al-Hasa (Margaret Glass, Arizona State University, Tempe, AZ). Additional faunal work is underway for the 1997-98 seasons, as well as for the site of Tor Sageer (Leslie Hartzell, Bishop Museum, Honolulu, HI).

4 K. al-Moumani (personal communication) kindly explained details of the major geological formations in the region.

5 Phytoliths were studied by Arlene Rosen, Institute of Archaeology, UCL.

6 Pollen previously reported from Yutil al-Hasa is from Area B, another section of the late Upper Palaeolithic occupation (Olszewski *et al*. 1990:46) see Note 3.

7 The microburin technique is several thousand years older in Jordan than in the western Levant, where early Epipalaeolithic backed microliths are manufactured without this technique (Byrd 1988:263; Goring-Morris 1987:122, 179).

8 Clark *et al*. (1988:242) lists the identification as *Equus hemionus/asinus*. In this time range, *Equus asinus* is probably the African wild ass (also *Equus africanus*); this species is poorly known (Martin 1998:162).

9 The are two other gazelle species, *Gazella gazella*, mainly a woodland and lush grasslands species, and *Gazella dorcas*, a desert species that is thought to have entered the Levant after the end of the Pleistocene, and thus after the temporal period under consideration here (Tchernov *et al.* 1986).

20. The Levantine Upper Palaeolithic: A Commentary on Contributions to the Philadelphia Symposium

Lorraine Copeland

Only four years ago this writer commented on the papers delivered at a conference on Near Eastern prehistory as a whole (Copeland 1997). This time the subject is the Levantine Upper Palaeolithic, and it is clear that, although new data have become available, many of the conundrums discussed then persist today. One such concerns the dating – dates that 'don't fit', (*cf.* Kuhn *et al.* herein). As we shall see, things are far from 'hunkey dorey' in the state of our chronologies. Another concerns the interpretation of cultural identities (Ahmarian, Aurignacian, a 'third entity' or 'none of the above' *cf.* Kerry and Henry herein). At the same time, during the interim, perceptible shifts in the viewpoints of authors seem to have taken place; many more authors now express unhappiness with the present taxonomic framework. A prevailing theme, a preoccupation even, can be discerned in these papers that can be summed up thus: variability, variability, variability or (to misquote an ex-President): 'It's variability, stupid!' Authors now accept that assemblage variability in the Levantine Upper Palaeolithic is more prevalent than was once believed and some go further in suggesting a number of possible causes (*e.g.*, Kaufman; Phillips and Saca herein). Cultural co-existences, or at least regional overlaps, are now accepted (*e.g.*, Coinman herein) – this in a region where once there was only Aurignacian and where, later, only two entities (Ahmarian and Aurignacian) were thought to exist (see references cited in many of the contributions). In short, the dichotomy, or two-tradition model seems to have collapsed; as a result some of our cherished ideas (such as the one that industries alike must be contemporaneous) may have to be re-examined. However, I think that the break with the dichotomy theory can only represent a sense of realism and a willingness to 'tell it like it is' (see the editors' introductory paper herein).

An important group of papers is devoted more to the earth sciences than to lithic matters: for example a comprehensive, if rather gloomy, review of how little we know of the Pleistocene fauna (Rabinovich); anthropogenic cave sediments which are also artefacts (Goldberg); speleothems, which have provided a climatic chronology for Soreq Cave during the last glacial (Bar-Mathews and Ayalon herein). As to the lithics, ingenious methods, designed to pin down the identity and lifeways of the various groups are presented. For example, use-wear analysis, and/or refitting, as well as thorough in-depth assemblage studies which go beyond not only formal classification but also beyond that other typological system (of the technology this time) – the *chaîne opératoire.* From these studies can come inferences as to site function, group tradition, stylistic/idiosyncratic behaviour, hunting strategies, environmental constraints, *etc*., *etc*. (*cf.* Kaufman; Tostevin; Williams; Monigal; and others). Phillips and Saca point out that some of the variability stems from small populations, which would lead to group isolation and so to lithic tradition differentiation (think Galapagos finches!). As Marks once remarked (1997), results from certain research procedures (such as use-wear analysis) have to be taken on trust by archaeologists, *i.e*., often they cannot be checked out personally. I wish that I was as confident of the interpretations presented by Williams (herein and references cited), and of his conclusions, as he is. In my view, there is an aspect missing from these investigations whereby little attention is given to the nitty-gritty – the day-to-day routines – of whoever was doing the knapping. Were they teenagers? Did they learn from their grandfathers (if the latter were still living) or from a clan expert? What effect could such matters have had on the group knapping traditions? I don't suppose that we'll ever know.

I propose to comment chronologically on what appear to be the various Upper Palaeolithic stages as they develop through time. I am assuming that the earliest dated manifestation of the Levantine Upper Palaeolithic is that of Boker Tachtit level 1 at *ca*. 46,000 bp (see Appendix 1). The Upper Palaeolithic start is defined as the magic moment when there was a sudden switch (or at least it appears to be sudden to us) to an Upper Palaeolithic toolkit made on blanks still produced by Mousterian techniques. This moment is estimated to have occurred around 50,000 bp by Mellars and Tixier (1989), cal-

culating back from later dates at Ksar Akil. It concerns (besides Boker Tachtit), Antelias Cave, Abu Halka and Ksar Akil. Following Bar Yosef (1994), I will use the term Emiran when referring to the industry of this earliest Upper Palaeolithic phase.

However, before diving into the Upper Palaeolithic sequence, I must applaud Tostevin (herein) for having a go at the question of Upper Palaeolithic origins. He points out that there must be antecedents; anthropological entities do not emerge fully formed like Venus on her half-shell. I would like to add that such a search is necessitated due to the missing stratigraphic link in the Levant at the time of this switch. There is no earlier (Mousterian) level below Boker Tachtit level 1; there is an erosional disturbance at Ksar Akil between the Mousterian and the Emiran/Transitional layers (henceforth Emiran), and there is a cultural gap at Kebara, where the last Mousterian is followed by Early Ahmarian (Bar-Yosef and Belfer-Cohen 1996). Abu Halka's Emiran level IV was also without an underlying occupational layer. Many cave sequences end with Late Mousterian (*e.g.*, Amud, Nahr Ibrahim). Only at Umm el-Tlel in the Syrian steppe/desert is there continuity – of a sort – in a most un-western Levantine form and date (see below). Tostevin presents a procedure, based on technological analyses of the lithics, for distinguishing between intra-site and imported innovations in an assemblage, with a view to identifying Upper Palaeolithic antecedents. He tests the structure, comparing Kebara VI (Late Mousterian) with Boker Tachtit level 1 (Early Upper Palaeolithic). The results indicate that it is unlikely that the Kebara VI knappers were ancestral to those who made the Boker Tachtit artefacts. However, I have often had the heretical thought (already alluded to above) that a study of only the technology can lead into a *cul-de-sac*. So what, if variability in the knapping options (read 'technical signature') chosen were noted? After all, father and son, sitting side by side, could have practiced different knapping paths to the same end. Furthermore, is the possibility of external origins somewhat academic? Do we know of any candidate(s) within shouting distance, let alone south of the Balkans? For the moment, we seem to be stuck with an origin in some local, anatomically modern but typo-technologically Mousterian human group (such as the people of Qafzeh), which is the parsimonious view. Another intriguing question in considering the switch is: why the shift from reliance on *racloirs* and points to mainly endscrapers and burins, both presumably designed to provide and/or process dinner, occurring pan-Levant at roughly the same time?

The Earliest Levantine Upper Palaeolithic; The Elusive Emiran, Transitional and Related Sites

A list of sites pertaining to this phase was confined until recently to Boker Tachtit 1–4 and the Lebanese trio of Ksar Akil 25–22/21, Antelias Cave 7–5 and Abu Halka IVe-f (*cf.* Copeland 2000 and references therein) together with the western Israeli cave sites. The lithics at the first-mentioned four sites gave us a good idea as to what a transitional Middle to Upper Palaeolithic industry might, or should, look like: *not* a mixture of Middle Palaeolithic and Upper Palaeolithic tool-types but rather a combination of Middle Palaeolithic technologies with exclusively Upper Palaeolithic tools. The scarcity of related sites in other regions due to lack of research in the east and north has now been remedied and has resulted in early Upper Palaeolithic sites turning up in, *e.g.*, the desert fringes (Fox herein and see below).

The original Emiran assemblages in the Israeli caves have been discussed before (Volkman and Kaufman 1983), and are here dealt with in a timely, even if it failed, effort to integrate them into the Middle/Upper Palaeolithic sequence at Raqefet (Sarel and Ronen herein and references therein). The evidence they provide clearly indicates (to me, anyway) that not two but three components could be present: Emiran, Mousterian and Aurignacian. The latter is evidenced by the presence of twisted debitage; as we now know this is not present in the earliest Upper Palaeolithic (Boker Tachtit) or in the Ahmarian, *e.g.*, at Ksar Akil (*cf.* Bergman herein). On this basis alone (and others could be cited) I conclude that the levels concerned contain a mixture, probably due to erosion. It is still puzzling why rolled, abraded or fresh implements of all three periods occur in each level without spatial distinction in all the squares at Raqefet.

An early candidate for the Transitional slot was Jerf Ajla layer Brown I (Schroeder 1969). Although Schroeder and his team in the new excavations there have been able to divide Brown I into three layers: A, B and C, no clear sign of an unmixed Transitional facies has emerged, even though certain characteristic tool-types such as Umm el-Tlel points are present (Schroeder personal communication). However, work continues in more promising areas (Julig *et al.* 1999). Of much interest are the dates on burnt flint: an average of 36 ky for C1. Although in conflict with the Boker Tachtit date of *ca*. 46,000 bp, this is comparable to dates of the *Intermédiaire* layers at Umm el-Tlel in the same region, and in the same general stratigraphic position between Middle Palaeolithic and Upper Palaeolithic. The excavators ask: have we here implications of a longer-lived early Upper Palaeolithic in the desert steppe at these two sites?

The three transitional layers at Umm el-Tlel have now been dated (in layer III2a') to *ca*. 36,000 bp (Boëda *et al.* 1996), but they are, curiously, termed '*Mousterien Tardif*' by Bourguignon (1996). Since the assemblages represent a survival of Levallois techniques (although with an Upper Palaeolithic tool kit), perhaps '*Levalloisien Tardif*' would be a more appropriate name. While lacking Emireh points or *chanfreins*, the two upper assemblages are characterized by tiny Levallois points that have been proximally thinned before detachment from the core: the Umm el-Tlel points. But what are we to make of the assertion that

the lowest intermediate level, III2b', is Ahmarian (Bourgignon 1998: 710)? The dates would fit in with certain Ahmarian dates elsewhere, (*e.g*. Lagama at *ca*. 32,000 bp, Boker A at 37,000 bp and of course Üçağızlı, as noted by *e.g*., Bar-Yosef and Belfer 1977; Monigal herein; Fox herein; Coinman herein; Kuhn *et al.* herein; 2001 and references therein). So are we now to regard the upper two layers as not intermediate between the Mousterian and the Upper Paleolithic but between the Ahmarian and the Aurignacian? At the same time, Bourguignon makes it clear that these three assemblages have nothing to do with either the underlying Mousterian or overlying Aurignacian. Furthermore, the Umm el-Tlel excavators insist that, unlike Boker and Ksar Akil, there is no indication of a 'developmental' transition between the three layers, even though in each case, just as in the underlying Mousterian, the object of the knappers was the formation of a triangular point, Levallois or not. Perhaps the reports now 'in press' (which I have not seen) will provide solutions.

The 'Umm el Tlel point' has not been reported in the west. Nevertheless, in all but date, these assemblages fulfil the expectations of a transitional Middle Palaeolithic to Upper Palaeolithic industry. One can ask: what was the advantage of retaining use of the Levallois techniques? Environmental constraints perhaps? But this idea would seem to be contradicted by the evidence from another desert site: Tor Sadaf in eastern Jordan (Fox herein), where a similar scenario cannot be evoked. This site, in the Wadi Hasa drainage, is undated; it produced a 1 m deep sequence with a recognisably 'Emiran' assemblage at the base (although without Emireh points or *chanfreins*), dubbed 'Tor Sadaf A and B'; the lithics developed technically upward into a recognisably Early Ahmarian assemblage at the top: 'Tor Sadaf Early Upper Paleolithic'. As Fox notes, this sequence shows, firstly, that the Early Ahmarian originates here in the late transitional/Emiran facies of the Levant, and secondly it does so developmentally, with the typology and technology not in synchronization, just as at Ksar Akil and Boker Tachtit. In this it differs from Umm el-Tlel, with its three 'non-developmental', non-Emiran facies. Furthermore, it shows that the switch to a blade technology did not occur only in the western Levant. One can but hope that a date will be obtained for Tor Sadaf.

Other possibly transitional sites occur in the Wadi Hasa area (Coinman herein) and even further south (*cf.* Henry 1997), but at the time of writing no other conclusively Emiran or related site has been reported. Although the lower levels G-1 at Üçağızlı in the Hatay just scrape onto the list at the end of the phase (Kuhn *et al.* herein), the assemblages were likened to that of Ksar Akil XXI, a level that marks the switch to Ahmarian (Ohnuma 1988).

The assemblages in question at Üçağızlı are not dealt with in detail in this volume, in which the later levels are described, but an earlier paper (Kuhn *et al.* 1999) gives some information on them, as well as an uncalibrated date for layer H of *ca*. 31,000 bp (and *cf*. the more recently reported date of 38–39,000 years; Kuhn *et al*. 2001). Although only a small sample was then available from layer H, it certainly seems to correlate with Ksar Akil XXI. So, if the start of the Emiran is still missing at the site, is the term 'Initial Upper Palaeolithic' the right one to use? Such a term should refer more to the start of the phase, *i.e*., Ksar Akil XXV or Boker Tachtit level 1. But watch this space; work continues at Üçağızlı. The site is one of the numerous tunnel-like cavities seen on this coast, formed by karstic water circulation under pressure as described by J. Besançon (2000) in his recent geo-morphological study of the Hatay Quaternary. The cave was invaded by the sea during the various marine oscillations of sea-level, each of which left traces in the form of Vermets and lithophages (at 22 m), wall breccias, pebble conglomerates on abrasion benches (at 32 m), as well as wash-outs, rockfalls and weathering erosion (Besançon 2000:24–5). The whole system is regarded as correlating in general with the well-known cave sequences on the eastern Mediterranean coast, founded on the premise that, at least as concerns the lower range of raised beaches, this coast moved eustatically as one block (Sanlaville 2000:98). According to Goldberg (herein), the early anthropogenic deposits were found on a beach at 18 m a.s.l. (see also Kuhn *et al.* 1999 and herein); the latter suggest that the lower occupation at Üçağızlı took place at a period of relatively high sea-level, presumably a Wurmian interstadial (Isotope Stage 2?), *contra* – Bar Matthews' timetable, which indicates a low sea-level of minus 12 m then. Not all coastal evidence is helpful; the Emiran levels at Abu Halka were laid down at 12 m a.s.l., on an abandoned raised beach of much earlier date (Isotope Stage 5).

Dating Problems

Before continuing with the sequence, a few remarks about the dating anomalies that seem to have arisen in the next, Early Ahmarian stage (already discussed in the editors' paper herein). Most of the data have come from the southern Levant; to redress the balance I will make use of the long (the longest, in fact) Upper Palaeolithic sequence in the Levant, that at Ksar Akil. It is only partially dated; there are no dates between the Mousterian at 46,000 bp (C14; obtained early) and the Aurignacian at 32,000 bp, and there is a hiatus in level XIV, just before the latter (Mellars and Tixier 1989). If the transition at Ksar Akil started at broadly the same time (*ca*. 46,000 bp) as at Boker Tachtit, there are more than 10 m of occupation deposits that were laid down between the locations of the two dates. The deposits consist of 2 m of Emiran, 2 m of Early Ahmarian, 5 cm of the hiatus layer XIV, then 2 m of Aurignacian A (levels XIII–XI) and some 50 cm of the start of Aurignacian B (levels X-IX) before we arrive at the proposed equivalent depth (as between the Ewing and Tixier excavations) dated to *ca*. 32,000 bp (for Tixier, this is his level 12, phase VII–VI; see Bergman herein

and also Copeland 1987). Accordingly, the Emiran could have 'transited' into the Ahmarian around *ca*. 40–42,000 bp (*cf*. the start of the Ahmarian at 43–42,000 bp in Kebara; Bar Yosef and Belfer-Cohen I996, Table 2) and the first Aurignacian might have occurred around 37,000 bp (Bergman herein) followed by the start of Aurignacian B. The dates at Kebara largely support these suppositions.

The trouble with this scenario is that it does not fit in with the situation in other southern and north-eastern areas. Transitional and/or Ahmarian occupations occur (according to the published dates) at the same time as the Aurignacian era at Ksar Akil and Kebara, at which sites their Ahmarian phase had already taken place. An explanation based on co-existence of the cultures does not account for the dislocated sequence – why the time difference between Ksar Akil's and Kebara's Ahmarian and the Ahmarian elsewhere? As Kuhn *et al.* suggest, more and better dates are needed to sort this out.

The Second Upper Palaeolithic Stage: The Expanding Ahmarian

I find very odd the mentions in this volume of the Early Ahmarian as the 'Earliest Upper Palaeolithic' (Coinman herein), or the 'Initial Upper Palaeolithic' (Kuhn *et al*. herein), but, sorry you-all, in my view such terms should surely be applied to the earliest Emiran assemblages from their start (Ksar Akil XXV–XXII/XXI and Boker Tachtit. I realise that we are relying very heavily on the 46,000 bp date at the latter site (horrors, supposing it turns out to be wrong!).

What is now known as the Early Ahmarian phase in the Levant was previously known (at Ksar Akil) as Ksar Akil Phase B (Azoury 1986). It gets a good coverage in this volume, and especially as concerns the southern sites. The expansion of the list of Early Ahmarian sites during the last two decades, due in part to the addition to it of assemblages formerly termed Aurignacian, represents a reversal of fortunes for the erstwhile reigning Aurignacian, now sometimes relegated to the status of an intrusion from 'elsewhere' – that useful place – into a northern/central Levant and then (controversially) into the southern Levant region that was envisaged as occupied by Early, then by Late Ahmarians in a continuum (*e.g.*, Coinman herein; Phillips and Saca herein; Monigal herein and *cf*. their references). Several variants were distinguished, such as at Lagama, or Boker A in the Negev, sites in southern Jordan and in the Tor Sadaf upper levels in the Wadi Hasa. Several authors have picked the Early Ahmarian techno-typology apart and reconstructed it, either by refitting (Monigal at Boker A), use-wear analyses (Becker at Abu Noshra) or attribute analyses, so that its characteristics are laid bare. Becker's study was directed toward identifying behaviours at Abu Noshra. On the non-lithic front, implications as to behaviour have been hiding in unexpected places such as in the method of rubbish disposal at Üçağızlı (Goldberg herein).

Full understanding of the phase is lacking as regards the dating, as commented on above; not only are some important sites and sequences undated, such as those designated Early Ahmarian in the Wadi Hasa drainage (Coinman herein: Fig. 13.2), but there are ambiguities with the dates we have. One example, quoted in this volume: the Ahmarian at Uçagizli dates to *ca*. 32–29,000 bp, whereas at Ksar Akil similar dates come from Aurignacian levels.

It has always been difficult to pin down the level at Ksar Akil where the Early Ahmarian begins, since the sequence (as excavated by Ewing) is 'developmental'; the industry arises out of the Emiran, as at Tor Sadaf, and changes gradually upwards (Azoury 1986; Ohnuma 1988). The latter authors suggested a division into two sub-stages: a backed-point stage in which some Levallois technique survived (levels XXII/XXI–XIX) and a stage characterised by large el-Wad points (levels XVIII–XV), during which full blade core reduction techniques were utilised to make mainly straight (sometimes slightly curved) blades pointed by retouch, the 'Ksar Akil points' of Azoury.

In contrast to the now well-understood technological methods of the Ahmarians, the tool repertoire presents some problems, for example the el-Wad points. The mistake, I think, of adding (to Garrod's definition) the larger, Ahmarian straight point types to this class is discussed by Bergman (herein, and see Copeland 1986, iv–ix, where I deplored the inclusion of so many variants). As Monigal shows, they were one of many types of intentionally-shaped blade-tools, but the earlier straight ones were consistently made by a particular reduction sequence, during which hard hammers were replaced by soft ones and in which size did not matter (thus rendering the distinction between blades and bladelets arbitrary!).

As to other sites, as mentioned above, there is problematic data on the Ahmarian at Umm el-Tlel, where the Aurignacian was said to follow transitional, rather than Ahmarian, levels (Boëda and Muhesen 1993). At Üçağızlı it seems that the upper level B industries were the same as originally found (designated Aurignacian) by Minzoni-Deroche in another area, and they indeed contain the robust points referable to Ksar Akil XXI, as shown in the figures, herein, by Kuhn *et al.* Certain moderations of viewpoint are evident in the present report, as against that of 1999, for example the authors (who really have got real!) wonder if the dichotomy theory is not a straightjacket and that the Ahmarian is in danger of becoming just as much a dustbin category as the Aurignacian once was, an idea expressed (but less pungently) by some other contributors (see below), and recently by Belfer-Cohen and Bar-Yosef (1999: 129).

This brings up the question of Tor Fawaz in the Jebel Qalkha area (Kerry and Henry herein). Here the larger sample recovered in 1994 allowed an improved view of the techno-typology, leading to the suggestion that behavioural reasons connected more to the environment than to the lithics could explain the variability. The authors

regard the assemblage as having an 'ambiguous taxonomic identity'. Neither clearly Ahmarian nor Aurignacian techno-typological traits were present. They therefore do not place the site in the present 'interpretive conventional framework'. Hooray for variability!

So, environmental differences according to region are seen to loom more and more influential; the north (as any archaeologist who has worked in both regions knows) is definitely not like the south, and surprise, surprise, the east is not like the west either! This is well illustrated at the end of the Early Ahmarian – which is said, based on dates (and when these are lacking, on comparisons) to develop into the 'Late Ahmarian' at southern and eastern sites (*cf*. Olszewski; Coinman herein), in contrast to the west where this didn't happen.

A more culturally advanced Ahmarian seems to occur in the north (Uçağızlı, where shell ornaments were present) in contrast to the case of the desert fringes (survival of Levallois techniques at Umm el-Tlel). An extreme case of variability?

The Levantine Aurignacian, or Now You Don't See It, Now You Do

Three contributors are concerned with this phase: Bergman at Ksar Akil, Kaufman and also Williams in the southern Levant at Negev and Jordan Valley sites. As already mentioned, the taxon 'Aurignacian' has had a chequered career, as noted by the editors (herein and *cf*. their references). In the recent past it was demoted to the status of an intrusion by some workers (Bar-Yosef and Belfer-Cohen 1996) but it now seems to be going into phoenix mode. The phase is well represented in the long Ksar Akil sequence, where it has been given the seal of approval (as similar to the French Aurignacian) by both Bordes and Tixier (Bergman herein). It begins in level XIII following the Early Ahmarian and the hiatus of Stoney Complex 2. As Bergman recounts, in 1969 it was divided into three sub-phases (which have changed slightly since then): Levantine Aurignacian A (levels XIII–XI), B (levels X–IX) and C (levels VIII/Vll–VI), although the status of level VI is debated.

Aurignacian A was once only known from Ksar Akil. Until recently it was not appreciated that the Aurignacian contained many regional variants, some more marked than could be explained as the result of differences in site-function (*e.g*., caves *vs*. open-air sites). Since Ksar Akil's C phase was the only one to resemble the flake-oriented Negev version, the more blade-oriented A phase, which contained numerous bladelets, was regarded as really belonging to the Ahmarian sequence; on the same grounds, some doubts were expressed even about the B phase (Bergman 1987a:155). But we can now report that Aurignacian A lives! A similar facies is present in Units I-II at Kebara (Bar Yosef and Belfer-Cohen 1996) and at Umm el-Tlel, where it follows the intermediate levels (Ploux 1999).

The standard Aurignacian characteristics are well-known and include traits such as 'carinated technologies' in burins and endscrapers, presence of small, usually straight, el-Wad points, emphasis on flakes in the southern variants and presence of Aurignacian blades (*cf*. Williams herein). Bergman adds another: twisted debitage; he notes that this new reduction system represents a break with the past, and that it continues to be used throughout the A, B, C sequence at Ksar Akil, as also noticed by Tixier. As to the tools, carinated burins (or are they cores?) and el-Wad points have been the subject of lively debates. The latter (Font Yves for Garrod) were originally confined to small, twisted specimens. As I have already remarked, the addition of the larger, straight or slightly curved in profile types of the Ahmarian (*cf*. Gilead 1981a, *i.e*, the 'Ksar Akil' points of Azoury 1986), made by a different reduction method, has rendered the present definitions so wide as to be meaningless (Bergman herein). The latter gives a detailed account of the twisted and straight blade technologies and proposes, as an option, to confine the definition to the large points of the Ahmarian, although this would go against the original definition of Garrod.

Although it now appears that some Aurignacian variant is present throughout the Levant (Williams, *e.g*., at Divshon, Arkov, *etc*.), this view is not held by Coinman (herein) who sees no Aurignacian in the southern Levant and also doubts the value of the two-tradition model. Williams also sees a 'Non-Ahmarian' entity as well which could, he admits, loosely conform to the Levantine Aurignacian of the core Mediterranean zone even though the variability there is marked. He attributes some of this to the environment and to the choices made to cope with this. Kaufman, too, considers the possibility, of a third entity at some of the sites he studied (herein). As we have seen, such a possibility was also discussed by Kerry and Henry at Tor Fawaz (herein and see above). A similar view is expressed by Belfer-Cohen and Bar-Yosef (1999:129) who regard some supposed Aurignacian assemblages as 'impossible hybrids', making it imperative that a new taxon should be coined. More nails in the coffin of the dichotomy theory. As the blessed Dorothy once told me: if a hypothesis turns out to be wrong, abandon it and move on. It's the appliance of science.

As to Aurignacian sites not covered in this volume, at Hayonim the Aurignacian follows a Mousterian occupation and Bergman refers it to Ksar Akil A (1987:154). A late variant, cautiously termed 'Late Upper Palaeolithic', is attested at Jilat 9, dated to *ca*. 21,000 bp (Garrard *et al*. 1988a, b, in press). At Umm el-Tlel, Ploux (1999) notes that the 27 Aurignacian sub-layers of Geological Complex II are most like levels XIII–XI at Ksar Akil but we recall that when first reported the Aurignacian was assigned to phases A and B (Molist and Cauvin 1990). A provisional date of *ca*. 30,000 bp is mentioned and carinates are said to be plentiful, while el-Wads (twisted) are not (Ploux 1999). Unfortunately, the Aurignacian is 'floating' at Umm el-Tlel; intermediate/ Ahmarian below, and only Geometric

Kebaran above (at least as excavated so far), so it is not quite the 'reference site for the whole Levant' claimed by Ploux (I999).

The new excavations of J. Tixier at Ksar Akil brought new light on the last part of the Aurignacian sequence there, which is seen as a development *in situ* without breaks (Tixier and Inizan 1981). The lowest point reached in Tixier's frontal section is thought (see Bergman herein) to correspond to Ewing's levels IX–VIII (end of B, start of C). There are several dates: *ca*. 30/29,000 bp for Tixier's Phase IV–III and *ca*. 26,000 bp for Phase III (Mellars and Tixier 1989). Calculating backward, the A phase could have begun *ca*. 37,000 bp (Bergman herein).

The latter author prefers to confine Aurignacian C at Ksar Akil to levels VIII and VII, omitting level VI (discussed below). Once termed 'Atlitian' in the western sites and regarded as 'impoverished', the flake-oriented Late Aurignacian at Ksar Akil appears, in fact, to be the most classically Aurignacoid of the three sub-phases. However, some workers regard the C or Atlitian phase as ripe for elimination as it is too confusing even in the south (Belfer-Cohen and Bar Yosef 1999:129).

It would seem that an important Aurignacian marker (especially in phases B and C) is the presence of art objects in the form of bone and antler tools and ornaments (however, remember the earlier exception: Uçagizli). The Aurignacian at Hayonim is particularly rich in this respect. Belfer-Cohen and Bar-Yosef (I999) point out that other tools, such as the split-based bone points, indicate affinities with the European Aurignacian. To note in passing: the Balkan Aurignacian sequence has also been described as 'developmental' (Kozlowski 1999; and *cf*. Tostevin's paper herein). Ochre-stained pebbles at Ksar Akil (and *cf*. those reported by Minzoni-Deroche *et al*. 1995 at Uçağızlı), are regarded as having a more utilitarian (grinding?) function than as from use as an artist's pigment (Bergman 1987a).

In sum, the Levantine Aurignacian does not lag behind the other taxons in the variability stakes. Will we end up by expunging taxons altogether?

The Late Palaeolithic in the Levant; A Veritable Can of Worms

The title of Olszewski's paper says it all: the conundrum she refers to is the apparent contemporaneity (according to dates obtained) of occupations judged typologically to represent both the 'Late Upper Palaeolithic' and the 'Epipalaeolithic' in the Wadi Hasa drainage. This is an area richly endowed, with large, sometimes multi-period sites. In a wider context, in spite of a plethora of data from virtually every other Levantine region, the course of the cultural development after about 19,000 bp, *i.e.*, following the Aurignacian era, remains extremely complex. This is partly due to the crumbling of the old linear interpretation of Atlitian to Kebaran to Geometric Kebaran and partly to the introduction of numerous named variants, not the least enigmatic being the 'Late Ahmarian'. This seems to be contemporary with the Aurignacian in some areas (see the contributions of Kaufman at Negev and Rift Valley sites, Nadel at Ohalo II [which had a 'Non-Kebaran Late Upper Palaeolithic'], Coinman and Olszewski in Wadi Hasa, and the editors). Although the latter draw attention to this second 'transition' (this time from Upper Palaeolithic to Epipalaeolithic), there is a lack of consensus as to where to draw the line between the two, the problem being that the time period is characterised by the increasing use of (rather than a sudden switch to) microlithic tools of extraordinarily variable morphologies. Authors ask, firstly: what is the relationship of a 'Final Ahmarian' with the Late Aurignacian in the areas where both did not occur (Kaufman), *i.e*., was the former purely a southern Levant phenomenon? Secondly, what is the relationship between the Late Ahmarian and the well-known Kebaran complex, regarded as Epipalaeolithic? Given the dating evidence, should the term Epipalaeolithic be dropped altogether (Nadel herein; Kerry and Henry herein; and see Gilead 1984a)? But, if a continuum is proposed, there would have to be stages within it, established by good dates, and some way would need to be found to account for regional differences.

At Ksar Akil, Tixier's findings broadly corroborated those of Ewing; he found that the Aurignacian developed into a 'Proto-Kebaran'. In short no Late Ahmarian. Ewing's Level VI (no longer Aurignacian for Bergman) was characterised by new scraper and burin types and by numerous Dufour bladelets (Tixier's *'en virgule'*). Unfortunately, Ewing's two uppermost levels I and II (referable to Kebara C; Belfer-Cohen and Bar-Yosef 1981) had been lost to erosion and quarrying and were unavailable to Tixier, who starts his level I at Ewing's III–IV.

Can the scenario at Ksar Akil's immediately post-Aurignacian phase be linked to those from other regions by other than imprecise dating? Perhaps yes, where have we seen before the denticulated, saw-like Ksar Akil scrapers? Ah yes, I published some (Copeland 1982); not only do they occur in Ksar Akil level VI (of Ewing, Tixier's IV) dated to *ca*. 23,000 bp but also in the Negev (Boker B/E5; Jones *et al*. 1983, dated to *ca*. 25,000 bp) and now also reported from Thalab el-Buhira, loci C and E, dated to *ca*. 22,000 bp (Coinman herein). Whether this indicates co-existence or not, it evokes an old question: do ideas or people travel?

The rockshelter site of Jiita, a few kilometres from Ksar Akil in a closely similar niche, almost duplicates the situation seen in the upper levels at Ksar Akil: an evolutionary development up the levels. The investigations of Hours (1973) were interrupted by the Civil War, but the succession seen so far from the top down is of a Kebaran with Kebaran points (level II), overlying an Early Kebaran with Dhour Choueir points (level Ill), below this was Early Kebaran with triangles (level IV), below which was a Pre-Kebaran with deposits less microlithic, containing more endscrapers and burins (level

V; see Besançon *et al.* 1975–77; Melkhi in preparation). It is to be recalled that, as a dramatic illustration of Late Palaeolithic microlith variability, the typology of the microliths at the two neighbouring sites, presumed to be contemporary, is not the same (at Ksar Akil microburins, micropoints and Dufour bladelets held sway). This somewhat undermines the regional difference explanation for (at least typological) variability!

The problems are surely not beyond solutions, however. Each author suggests that cultural distinctions can be discerned through study of, *e.g.*, spatial patterning, indications of site use and function, *etc*. New dating projects could settle the question of regional co-existences. Agreement could be reached concerning arbitrary cut-off points, for example a sequence with a 'Pre-Kebaran' assemblage would be termed 'Kebaran' with the first appearance of obliquely-truncated bladelets (*i.e.*, Kebara points, see Nadel herein). However, we are probably not yet ready for the imposition of such rules; some maverick would surely ignore them. I think the solutions will come from more and better dates. If and when these are obtained, we should have another symposium dedicated to the end of the Levantine Upper Palaeolithic/Epipalaeolithic.

By then perhaps we shall have in place some pieces of the puzzle that are not yet to hand, such as archaeological data from East Jordan (Wadi Jilat; Azraq; Garrard *et al.* in press), as well as the many environmental data (fauna, pollen) reported to be under study (Rabinovich herein). There are gaps in the database from the northeastern areas, *e.g.*, Jerf Ajla where there is a newly-found Epipalaeolithic phase (Julig *et al.* 1999), as well as the results of the surveys and excavations of Garrard and others in south-east Turkey. This data is needed in order to balance the larger amount of information from the southern Levant concerning the Late Ahmarian. In this connection Kuhn *et al.* question the use of the term 'Late Ahmarian' (in case it becomes a dustbin category; see above).

Postscript

The editors are to be congratulated on the realisation of this volume that contains so many valuable papers. They hoped that the contributors would squeeze meaning from the silent stones beyond lithic techno-typology; several have done just that. I regret that it was impossible to do full justice to all the points made and all the details set out in the numerous papers, and I apologise for the omissions.

21. Reflections on Levantine Upper Palaeolithic Studies: Past and Present

Anthony E. Marks

Introduction

During the first Lyon Prehistory of the Levant Conference in 1980, I made the following comment as part of a general reflection on past Upper Palaeolithic studies:

> 'At the beginning of the last session, Dr. Jelinek noted that Middle Palaeolithic studies in the Levant traditionally tended to generate much heat, if not much light. It is quite different for the Levantine Upper Palaeolithic studies; they have tended to generate neither heat nor light.' (Marks 1981b:369)

Some twenty years later, I find myself, again, reflecting upon Levantine Upper Palaeolithic studies, mainly in the context of the papers presented in this volume. Since no single volume exists in a vacuum, my reflections will consider a number of recent contributions, which, combined with this volume, call for a quite different evaluation of Levantine Upper Palaeolithic studies than that cited above. In the past twenty years, we have seen a bit of heat and even some light. Most encouragingly, while the light may be still at the end of a tunnel, the tunnel itself seems not so long as it did even ten years ago.

The present state of Levantine Upper Palaeolithic studies mainly derives from a few factors over the past twenty years: the suggested Ahmarian/Levantine Aurignacian dichotomy (the Two Tradition model); the impressive increase in published assemblages from areas almost unknown prior to 1980 (Turkey, northern Syria, Jordan, *etc*.); a focus on finding criteria for dividing up continuity into major classificatory units (*e.g*., Epipalaeolithic *vs*. Upper Palaeolithic); and, most recently, from the effects of the Out-of-Africa model on interpretations of Levantine Upper Palaeolithic origins. All of these are directly encountered in the papers in this volume, as well as in numerous other recent works.

Much of this paper will consider the most contentious; how to model the increasingly complex assemblage variability coming from both newly excavated sites and from restudied older collections. A number of proposals will be made that call for more detailed consideration on both theoretical and practical levels. It is time, however, for us to get our Upper Palaeolithic house in order.

My approach to bringing order to the present chaos in Levantine Upper Palaeolithic studies is unabashedly technologically oriented to establish a rational classificatory framework for the period. This does not deny significance to typology. Rather, it distinguishes what is truly technological from what is typological. It also assumes that technological patterns are more stable than typological ones and that the latter are directly affected by a myriad of immediate situations which do not so affect technology.

The Two Tradition Model

It is somewhat ironic, given the above quote, that two papers presented at the First Lyon Conference generated much of the heat of the past twenty years. These papers (Gilead 1981a; Marks 1981a), suggested that the traditional unilinear developmental model of the Levantine Upper Palaeolithic (Neuville 1934) was not consonant with the then available data from the Negev and Sinai. The proposed alternative was the presence of two different lithic traditions in the southern Levant – Ahmarian and Levantine Aurignacian.

The models, presented by each of us working independently, sounded very similar: we each believed that, given the then available absolute dates, general patterns of Upper Palaeolithic lithic assemblage variability could be explained most parsimoniously as resulting from two distinct lithic traditions, which partly overlapped both temporally and geographically. Each of us, however, based his conclusions upon essentially different criteria: mine was based mainly upon time transgressive differences in core reduction strategies (Marks 1981a:346), while Gilead's was essentially, but not exclusively, based upon typological patterns through time (Gilead 1981a:337). It also may be that our understanding of 'tradition' was different, although unarticulated. In spite of these differences, our ideas were merged into what has been called the Two Tradition model (Williams herein).

My experiences trying to use typology to establish assemblage relationships in the central Negev resulted in the conclusion that '… typologically, no two assemblages clearly represent the same cultural manifestation' (Marks and Ferring 1977:205). This led us to consider the potential analytic virtues of technology:

> It is recognized that the whole question of technological traits and patterns has not been dealt with here, and that they may well provide useful criteria for comparisons. In fact, such studies are now in progress and suggest still another clustering of these assemblages, which cross-cuts all those so far attempted. These studies may well provide evidence for specific traditions which would be less effected [*sic*] by activity variation than would typological criteria. (Marks and Ferring 1977:205, note 2)

During the same year, I wrote '… it is possible to recognize two probable traditions, although there are assemblages which do not fit easily into either' (Marks 1977b:19) and that one of these traditions 'in the broadest sense . . . is the Levantine Aurignacian of the northern Levant' (Marks 1977b:20). At that time, I was struggling to integrate typological characteristics with technological patterning, such as blank production and tool blank selection (Marks 1977b:19–21). I had not fully understood that most of the tool types that seemed to me characteristic of a single lithic tradition were characteristic by virtue of the blanks on which they were made and/or the way they were retouched. In reality, *the truly diagnostic attributes were technological, not typological.*

In spite of twenty years of quite widespread use, the Two Tradition model has been heavily criticized but, unfortunately, not improved upon. Many are dissatisfied with one or more aspects of it. There is a frustration that, as often applied, it does not always permit easy assemblage classification into one or the other tradition (*e.g.*, Kerry and Henry herein). It is also criticized for failing to account for all the Levantine Upper Palaeolithic lithic and, even, non-lithic, assemblage variability (*e.g.*, Belfer-Cohen 1994; Belfer-Cohen and Bar-Yosef 1981; Bar-Yosef and Belfer-Cohen 1996; Belfer-Cohen and Goring-Morris 1986; Coinman 1990).

Unlike others who felt or still feel uncomfortable with the dichotomy between the Ahmarian and Levantine Aurignacian, Goring-Morris had no such problem (Goring-Morris 1988:81). Rather, he objected to one of its core underlying assumptions – some temporal overlap between the two traditions. Of all the criticisms, Goring-Morris' was both the most serious and, yet, the most potentially constructive for the field, since he actually argued his position, presenting data to back up his ideas, as well as proposing an alternative model: a return to the unilinear developmental sequence, as proposed by Neuville and Garrod (Goring-Morris 1987:57).

As noted by Goring-Morris (1988), at that time (and still today) there were a very limited number of dated sites from the southern Levant and most of these were Ahmarian (see Kerry and Henry herein). This did make the southern Levantine radiometric data problematic, both for the contemporaneity argument and for negating it. Also, the southern Levant lacked deeply stratified Upper Palaeolithic deposits, thereby excluding evidence for predicted tradition inter-stratification. In fact, had the southern Levant been a true isolate, Goring-Morris' argument against contemporaneity would have been reasonable. Even then, however, data from the northern Levant did indicate some temporal overlap (Marks 1988), although the data from the Negev, as we noted, '… fail[*ed*] to *prove* contemporaneity' (Marks and Ferring 1988:68).

Today, a temporal overlap of what is called the Ahmarian and the Levantine Aurignacian is manifestly clear. It is now fully accepted that the Ahmarian developed out of a Boker Tachtit, Level 4, type assemblage somewhat prior to 40,000 bp (Bar-Yosef 2000; Fox herein; Kuhn *et al.* herein) and lasted until *ca*. 19/20,000 bp, when it evolved into the Epipalaeolithic (Bar-Yosef 2000; Coinman herein). Although significant developmental changes in technology can be seen between what has been called Early Ahmarian and Late Ahmarian (Ferring 1988; Marks and Ferring 1988) or Masraqan (Goring-Morris 1995b), the basic continuity remains identifiable (Coinman herein). With this now established beyond argument, the Levantine Aurignacian clearly overlaps temporally with the Ahmarian.

*The Concept of Lineage (*née *Tradition)*

Without question, my failure to clearly define *'tradition'* in 1980 (Marks 1981a) has both led to much confusion, as well as leaving its understanding up to each scholar who chose to use the term. The range of understanding of the Ahmarian and the Levantine Aurignacian, either together or separately, appears to be quite wide: the Ahmarian as both tradition and industry (Bar-Yosef 2000:130) and only as an industry (Monigal herein); both as 'archaeological cultures' (Phillips 1994:169) and 'culture groups' (Gilead 1981a:277; Bergman and Goring-Morris 1987); or 'analytic units' (Coinman 1990:346); the Levantine Aurignacian as a 'social network' (Bar-Yosef and Belfer-Cohen 1988:36); and, perhaps closest of all to my original meaning, the Ahmarian as a 'macro-technology' (Coinman 1997 herein). While this confusion was addressed almost 15 years ago (Gilead 1989:237), it was to little effect.

In spite of the different terms applied to the Ahmarian and the Levantine Aurignacian, almost everyone has used it in the sense of 'lithic industry,' and I see no hope that will change. Therefore, I propose that a new name be adopted to replace Ahmarian and Levantine Aurignacian, as *lithic traditions*, and that they continue to be used, but with clear technological definitions, as *lithic industries*. In addition, since *tradition* has been associated with Ahmarian and Levantine Aurignacian, and since

some do not appear to see any difference between tradition and industry, I propose to do away with the use of the term entirely and replace it with 'lineage.' Therefore, I propose that the Ahmarian Lithic Tradition, as proposed in 1980, now be called the 'Levantine Leptolithic Lineage'. In the case of the Levantine Aurignacian, as discussed below, it may not represent nearly as long a period as the Levantine Leptolithic Lineage and, therefore, may best be considered simply an industry with possibly two phases and two facies.

Lithic Lineage vs. *Lithic Industry*

So that the following history and discussion may be understood in context, I will provide definitions for lineage and industry first and then explain the reasoning behind the definitions. A lineage is a relatively low level of technological affinity, rather similar in that way to a technocomplex (Clarke 1978:495), except that emphasis is placed on technological continuity. It may encompass different modes of blank removal, different techniques of core preparation and reduction; it may even group together different concepts of core reduction. What is important is that, in spite of this variability, some significant, limited range of blank form is produced throughout. In the case of the Levantine Leptolithic Lineage, it is a dominant technological proclivity to produce elongated blanks.

A lithic lineage is defined as *a complex of technological patterns involving lithics, which, subject to modification, exhibits continuity in general goals through a long period and within a large area.* A comparable definition of tradition can be found in Laville *et al.* (1980:13–14).

A lithic industry, on the other hand, is similar but the levels of technological affinity are greater, the time is shorter, and the space is smaller. The following definition is proposed for use in the Levant: *a suite of lithic reduction procedures that, through time and space, utilized one or more closely related strategies to produce comparable clusters of blank forms, regardless of the specific activities to be undertaken or differing availability/kinds of raw materials. There is, as well, a general consistency, or demonstrable developmental change through time and/or space, in the patterning of blank selection for retouched tool production and in the kinds of retouch applied to those tools.*

Why Only Lithics?

Since 'tradition,' as used in 1981 for the Levant, referred commonly to '*lithic* tradition' (*e.g.*, Gilead 1981a:337; Marks 1977b, 1988:60), it is important why its definition, and that of industry, as well, was limited to lithics and why it still should be. The parameters, if not the definition, of lithic traditions in southern Levantine context were described as the following:

> In order for the two groups to be considered [*different*] traditions, as opposed to industries, there is an explicit assumption on my part that they are both temporally transgressive, have wide geographic range, and at any given time are generically unrelated to each other. In this particular case, it is also the assumption that they have considerable temporal overlap. (Marks 1988:60)

This, combined with the technological criteria (Marks 1981a) that had already been applied by the Central Negev Project prior to 1980 (Ferring 1976, 1977; Marks 1976b; Marks and Ferring 1976; Larson and Marks 1977), should have provided a reasonable conceptual and practical framework for understanding the term.

While it is not clear from the literature that there was any understanding, the use of such limited criteria has been criticized, with the suggestion that a broader range of material should be used:

> We feel that the overall picture requires a return to the more comprehensive old model that demonstrated the variability between assemblages in terms not only of the lithic technology but also the lithic typology, as well as the presence of bone and antler artefacts. (Bar-Yosef and Belfer-Cohen 1996:143)

Although this approach has virtue for defining an archaeological culture, its criteria are ill suited for the construction of a classificatory framework for the range and type of assemblages found in the Levant during the Upper Palaeolithic. Limiting the defining criteria of a lineage and an industry to lithics was and is reasonable and, in fact, necessary. The reason it must be limited to lithics is clear. In historical context, the majority of all Upper Palaeolithic sites in the Negev and Sinai were open-air and most were, at least, partly deflated. Those *in situ* tended to have surficial deposits. Only rarely were stratigraphically well preserved assemblages found and, even then, organic material preservation was poor (*e.g.*, Boker BE). In no case did the southern Levantine Upper Palaeolithic sites have the quality of preservation found in the cave sites of the central and northern Levant. More importantly, if the goal was to organize assemblages into groups with similar patterning of material culture, only that material could be used which was both abundant and survived under the most unfavourable conditions, lithics. Including artefacts such as bone or antler that are perishable as *necessary* criteria would have meant that only those sites with excellent preservation could have been classified.

What about those potential sites which represent ephemeral or specific activity camps (*e.g.*, Kaufman herein) of the people who were responsible for the rich and varied material culture at Hayonim Level D (Belfer-Cohen and Bar-Yosef 1981)? Should one expect that these people made and left bone tools, personal ornaments, perhaps, expressions of art at even traditionally revisited open-air hunting camps and that they survived to be

recovered by us? Hardly; yet, if such materials were part of the necessary criteria for the recognition of the Levantine Aurignacian, as suggested by Bar-Yosef and Belfer-Cohen (1996), the Levantine Aurignacian would be limited to cave sites with organic preservation. While this could be done, I do not see what purpose or insight would be gained by doing so. The most obvious limitation would be to make meaningful settlement systems studies virtually impossible by excluding ephemeral, activity specific open-air sites (quarry, hunting camps, *etc*.) of the Levantine Aurignacian. The Levantine Aurignacian would never be recognizable outside of a cave.

While bone tools or personal ornaments are products of technological patterns of manufacture, these patterns are independent of lithic technology. Without question, such information enriches our understanding of variability and, in fact, makes it possible to construct archaeological cultures, as opposed to less specific levels of affinities, such as lithic lineages or lithic industries. In cases where such artefacts are abundant, they can be used quite effectively to define similar or different patterns of non-lithic technology within and between industries defined on lithic criteria (*e.g*., Stordeur-Yedid 1979:189–192; d'Errico *et al.* 1998), but they cannot be merged with lithic criteria.

Why Not Typology, Too?

A more difficult question is the use of typological variability as defining criteria for a *lithic lineage* or a *lithic industry*, partly because retouched tools have been central to almost all assemblage descriptions and higher classifications (industry, complex, technocomplex, culture group, *etc*.), since the beginning of prehistoric archaeology. It is particularly relevant in the Levantine Upper Palaeolithic context because Gilead (1981a) specifically used differences in the proportional occurrences of some tool classes as criteria for differentiating the Ahmarian from the Levantine Aurignacian. While I did not do so, I certainly used retouched tools as complimentary evidence (Marks 1981a) and, in fact, wrote that there was a '… robust dependant relationship between basic lithic technology and retouched end-products' (Marks 1988:60) in the Levantine Upper Palaeolithic. Yet, emphasis clearly was placed on technology: 'It is held, in fact, that the basic technology of a group will determine, to a large extent, the morphology of its tools at the type level' (Marks 1981a: 346). Upon reflection, I, as so many others, had and, perhaps, still have trouble distinguishing the typological from the technological, particularly at the type level. They are not easy to separate, since all typological attributes are created by technological methods. Still, effective separation is possible and, in this case, desirable. At times, perhaps, the difference is almost semantic. In the example of the Mousterian of Acheulian Tradition (Peyrony 1930; Bordes 1992), bifaces, *per se*, were considered to be typological, although I would argue that the biface, *sensu lato*, is a technological category, reflecting a kind of reduction, *façonnage*, which is profoundly different from non-bifacial reduction (Boëda 1995b).

The reason to separate technology from typology at the scale of lineage and industry has been articulated, yet again, in some of the papers in this volume (*e.g*., Kerry and Henry; Phillips and Saca). Simply put, there are too many situational factors that affected both the production of specific retouched tools and the proportional occurrence of different tool classes in any recovered assemblage to use them as *necessary* criteria for either. My opinion, stated over 20 years ago, has not changed:

> I have little faith in intersite comparisons based on proportional tool occurrences, as a means for determining different traditions. First, it is now well documented that specific classes of tools often have non-random distributions across any living floor. Even within a model which expects no significant spatial differentiation, it is clear that the proportional occurrence of tool classes will be largely determined by the dominant activities carried out within any concentration. (Marks 1981b:371)

This opinion has been re-enforced, with the recognition that additional factors, such as differential understanding of typological definitions, relative intensity of occupation, the post-depositional history of any site, among other factors, also affect the tools we find and how we see them.

The exclusion of typology as a criterion in the definition of a lithic lineage and its possible minor role, if any, in the definition of an industry does not, in any way, negate the use of typology on other scales. The presence/absence of specific tool classes and/or types may well reflect cultural choices, particularly when these differences occur associated within the same technologies. The proportional occurrences of different tool classes clearly relate to activity patterning (*e.g*., Nadel herein; Olszewski herein), while the relative proportion of tools to debitage provides important information on possible differences in intensity of occupation and, even, types of occupation. At the industry level, retouched tools are certainly important as technology in distinguishing facies and phases. They may even help to differentiate among contemporaneous industries. Yet, in at least two different studies (Kerry 2000; Nadel herein) the proportional occurrences of major tool classes could not be used to meaningfully cluster multiple assemblages of similar periods.

The Technological Base

Technological criteria were chosen because they are the least likely to be significantly affected by variable situations, such as differences in raw material type and/or packaging, activity variations, intra-site spatial distributions, *etc*. Of the five main parts of a lithic reduction

sequence (*chaîne opératoire* in our current jargon) – raw material procurement, core shaping and reduction, tool production, tool use and maintenance, and discard (Pelegrin 1993; Perlés 1993; Sellet 1993), both *lithic lineage and industry* should be defined by activities that mainly fall within core shaping and reduction: those procedures which are required to produce desired end results. Tool production is also significant in the definition of an industry, but mainly when its technological aspects are considered (blank selection and modes of retouch).

The defining criteria of a specific lithic lineage or industry optimally should include those patterned activities that occur repetitively. At the same time, the criteria must not be so limited or specific that they exclude either flexibility of traditional actions or occasional aberrations. It also must be recognized that lithic lineages, industries, and their constituent parts, are abstractions, interpretations of the archaeological record. As such, they are always a work in progress.

The Levantine Leptolithic Lineage

There appears to be broad agreement that the Emiran developed into the Ahmarian, through a shift from hard hammer to soft hammer detachments, and that the Ahmarian, as currently used in the literature, evolved into the Epipalaeolithic, which, in turn, passed into the Natufian. From the Emiran to the Natufian, basic technology was oriented mainly to the production of elongated blanks. This continuity of purpose, over time expressed in very different ways, forms the basis for their inclusion into the Levantine Leptolithic Lineage. Since the Emiran dates to *ca*. 50,000 bp, at least at Boker Tachtit Level 2 (J. Rink personal communication), and the Natufian arises at *ca*. 12,000 bp or slightly later (Byrd 1994), this lineage can be traced for a bit less than 40,000 years. This much is not controversial. Personally, I would entertain the notion that the Emiran can be traced back into the Middle Palaeolithic, but that is beyond the scope of this argument.

Given the truly long duration of the Levantine Leptolithic Lineage, it is not surprising that it can be viewed as a sequence of lithic industries. I would suggest, at least, four industries and one complex of related industries during the Epipalaeolithic. The four Upper Palaeolithic industries are: 1) the Emiran, 2) an as yet unnamed industry which begins with Boker Tachtit Level 4 type technology and passes into 3) the Ahmarian, and 4) what has been called the Late Ahmarian or the Masraqan. Finally, I would include the pre-Natufian Epipalaeolithic complex as the final stage of the Levantine Leptolithic Lineage. This suggestion needs considerable examination, since when one industry passes into another, instead of into a different phase of the same industry, it must be justified in detail, rather than proclaimed. The proposed, unnamed industry, which begins with Boker Tachtit Level 4, now can be documented in the northern Levant at Ksar Akil levels XX–XVIII (Bergman 1987a), at Üçağızlı (Kuhn *et al*. herein), as well as in the south at Tor Sadaf (Fox herein). It is suggested that the technological shifts seen at these sites truly represent a transition in mode of blank detachment, from which, once completed, predictably emerged the fully Upper Palaeolithic Ahmarian. Therefore, it is suggested above that these assemblages and the technological shifts they document be classified as a separate industry, the Proto-Ahmarian or, if easier to say, the Üçağızlıan.

This paper will not attempt to define all of these industries and their possible technological facies and phases, although I have no doubt it can be done. Instead, I will define the Ahmarian and the Levantine Aurignacian, as industries, suggesting, here and there, where phases and facies might be found.

The Ahmarian Industry: a technological definition

In the Ahmarian industry, *sensu lato*, a single suite of related lithic reduction strategies produced not only a dominant series of elongated, parallel-sided, flat to slightly incurvate products but, also, a range of other, predictable blank forms. Although the elongated pieces were chosen, in the majority, as blanks for retouched tool production, other blank forms were consistently used in tool production.

The size of the blanks and the specific reduction sequences (*chaînes opératoires*) used to produce the dominant, elongated component may have varied over time and space, although a cluster of dependant, interrelated actions tends to characterize all Ahmarian reduction sequences. These not only pre-form the raw material to be reduced, if necessary, but also maintain the predictability of blank attributes through an ongoing reduction sequence.

The dependent, interrelated actions are inferred from attributes on lithic materials and include the following: 1) the selection of narrow edges of unmodified raw material for exploitation; 2) the use of cresting, when necessary, to pre-form the flaking surface; 3) the production of acute but unfaceted striking platforms; 4) the maintenance of striking platforms by core tablet removals and the re-orientation of flaking surfaces by platform blade removals; 5) the abrasion (grinding) of platform edges to prevent platform collapse; 6) the maintenance of flake surface convexities through the use of either overpassed blades or minor adjustments on the end opposite the platform in use; and, 7) the shift from a hard hammer to a soft hammer for blade/bladelet blank detachment.

The combination of these actions usually resulted in the production of blades/bladelets that were parallel-sided, flat or slightly incurvate and had small to minute platforms. The relationships among these actions, as they actually apply to blank production at Boker A, are discussed in detail by Monigal (herein) and on a broader scale by Coinman (herein).

All classes of blank types, except debris, were utilized in the production of retouched tools. Tool class was generally predictable by blank type. Thin, parallel-sided blades and bladelets were used almost exclusively in the production of tools with minimal modifications such as el-Wad points, inversely retouched points, retouched pointed blades/bladelets, Ouchtata bladelets, as well as marginally retouched pieces. Scrapers, burins and denticulates, on the other hand, were made predictably on larger, heavier, but still flat blanks. Previously (Ferring 1988), these blanks had been considered mere by-products of necessary core formation and maintenance procedures. While they certainly played that role, they now are seen to be a necessary, planned production of blanks for tools such as scrapers and burins (Monigal herein).

The tendency toward the dominant production of elongated pieces remained throughout the Ahmarian industry, and, in fact, through the Epipalaeolithic, as did the production of and selection of basically flat blanks for retouch. In addition, types of retouch tend toward non-invasive marginal to steep for the lighter tools and parallel to sub-parallel for the larger tools, such as scrapers. Scalar, stepped, and semi-steep scalar (Aurignacian) (Debénath and Dibble 1994:34; Brézillon 1971:113) retouch are rare to absent. One exception is the somewhat invasive, inverse retouch on numerous points at Boker A (Jones *et al*. 1983:299; Monigal herein Fig. 11.9:c, e, i) and there may well be other exceptions in the north (Kuhn *et al*. herein).

Early vs. *Late Ahmarian Technology*

Considerable variability within the basic Ahmarian technological parameters is recognizable during its span. Some variability appears to be diachronic, while other variability seems to be synchronic. The concept of an Early and a Late Ahmarian is firmly *established* in the literature (*e.g*., Bar-Yosef 2000; Coinman 1993; Coinman and Henry 1995; Ferring 1988; Marks and Ferring 1988; Phillips 1994). As noted above, however, they might be thought of, at least, as two different industries, rather than phases of one. While obviously in temporal context, the difference between Early and Late Ahmarian also has been defined as a shift from the single, highly dominant reduction strategy described above into two different but related strategies, which continued to produce a dominance of elongated blanks (Ferring 1980, 1988).

The specific reduction strategy of the Early Ahmarian continued to a small degree, but added to it were two modifications designed to produce different size ranges of elongated blanks. This can first be seen as early as *ca*. 26,000 bp at Boker BE, Level 3; by Ein Aqev East at *ca*. 20,000 bp, the Early Ahmarian reduction pattern was gone. In its place were two related strategies. In the first, large cobbles were reduced either unidirectionally or bidirectionally to purposely produce only large, heavy blades. While some of the preparatory actions of the earlier core formation and reduction were continued, the limited exploitation of these cores did not necessitate much core face or platform maintenance, while the sheer size of the blanks produced required detachment with a hard hammer. In a sense, this reduction strategy parallels the first part of actual blade production in the Early Ahmarian. During the reduction of these large cores, thick blades and flakes were removed which served both as blanks for tools and as cores for the production of bladelets (Ferring 1977:88).

These latter blanks, as well as some small nodule fragments, provided the core blanks for the third reduction strategy. This strategy, comparable to the smaller cores in the Early Ahmarian (Monigal herein), but much more numerous, left out the initial core shaping at times seen in the Early Ahmarian and began removal of bladelets from the very beginning. Given the shape and configuration of these pieces, initial shaping was superfluous. Since the length of the core flaking surfaces were already in the bladelet length range, there was little platform rejuvenation through a core tablet technique, and owing to the core's natural pre-forming, there was no need for cresting. When, however, the orientation of the core flaking surface was changed (a tendency found mostly in the Late Ahmarian), a platform blade was first removed. Platform edge abrasion continued to be used. In the Late Ahmarian, this efficient bladelet technology tended to produce a great number of blanks relative to the other reduction strategies.

The separation of these related strategies can be recognized in any Late Ahmarian assemblage by the obvious size clustering of the abandoned cores (*e.g*., Ferring 1977:93; Nadel herein). It is also seen in the bimodal distribution of blade *vs* bladelet lengths (*e.g*., Ferring 1977:90; Nadel herein), as opposed to the unimodal distribution in the Early Ahmarian (Monigal herein).

What is most striking about the use of these reduction strategies is that the symmetric, narrow, parallel-sided blades (from *ca*. 40 mm. to 60 mm. in length) used for el-Wad point production in the Early Ahmarian (Jones *et al*. 1983:294, 310; Bar-Yosef and Belfer 1977:47) virtually disappear. Not surprisingly, the el-Wad point, as a type, became rare and was replaced by smaller pointed bladelet tools. This might well reflect a change in hunting technology, perhaps, to the bow and arrow or, at least, to an increased popularity of laterally positioned barbs, as opposed to simple points.

Blank selection by tool class was the same as during the Early Ahmarian. Large blades were made into end-scrapers, burins, and even truncations. A new, although informal tool appears, the *pièce à mâchures*, made on the largest, heaviest blanks. Combined with the burins and scrapers, these form a group of very large tools, compared with the increasing diminution of the smaller bladelet tools. This dimensionally isolated large tool component, while never proportionately significant, is a continuing feature of most later periods (Late Ahmarian: *e.g*., Goring-

Morris 1987:67–68. Epipalaeolithic: *e.g.*, Marks 1976e: 304; Goring-Morris 1987:72, 75, 112, 150, 175, *etc*. Natufian: *e.g.*, Schroeder 1991:72; Edwards 1991:144; Marks and Larson 1977:217; Henry 1976:335, 339–341, *etc*.).

With the increased number of bladelets, marginal, non-invasive retouch continued – from very fine to steep, and Ouchtata retouch became dominant. Retouch on larger tools was still that typical of the Early Ahmarian; that is, it tended to be sub-parallel and only very rarely was it stepped, scalar, or 'Aurignacian.'

Other Intra-Ahmarian Variability

Do these definitions make it possible to assign any Levantine Upper Palaeolithic soft hammer blade dominated assemblage into the Early or Late Ahmarian? In theory, the answer should be yes. In practice it may well be no. The criteria for these designations are modal; the reality was otherwise, in every period (*e.g.*, Goring-Morris and Belfer-Cohen 1997:74). Certainly, there should be assemblages where there is some weakly developed tendency toward Late Ahmarian technological patterns (as at Boker BE Level 3) or other assemblages where the patterns that define the Early Ahmarian were only partly manifested, as will be discussed later. After all, the Levantine Leptolithic Lineage, in which the Ahmarian belongs, was one of continuity – perhaps, not even steady change, but continuity, nevertheless. Just how this continuity is broken up by us into industries, phases, facies, or even archaeological cultures, will depend upon how we organize our data and what significance we give to different patterns in the technological *and* typological repertoires within the Levantine Leptolithic Lineage.

Obviously, observable patterning goes way beyond lithics. Settlement systems (Marks and Friedel 1977), site placement across the landscape (Williams 2000), non-lithic technologies (Bar-Yosef and Belfer-Cohen 1996), the geographic distribution of exotic items (Kuhn *et al.* herein), patterns of raw material acquisition (Kaufman herein), correlations between industries and environmental zones (Goring-Morris 1995b), *etc*., all play important roles constructing our understanding of the Levantine Upper Palaeolithic. It is important, however, not to mix the various scales of affinities and differences that these kinds of observations document.

While it is beyond the scope of this paper to reconfigure the known Ahmarian assemblages into phases and facies, there are many possibilities that need further consideration. A few are listed below:

1) The Early Ahmarian of the Central Negev (Boker A and Sde Divshon), Jordan (Tor Sadaf and EHLPP1), and Sinai (the Lagaman sites), among others, appear sufficiently similar that they might be included within a single named facies.
2) The Early Ahmarian in the northern Levant (at Ksar Akil, Üçağızlı, and Umm el-Tlel) appears to have used both single platform and true opposed platform reduction to produce blades (Ohnuma and Bergman 1990; Bourgignon 1998; Kuhn *et al.* herein). This variation of the Early Ahmarian reduction strategy was rare, at best, in Sinai, the central Negev, and Jordan. Combined with some seemingly different patterns in tool production (Bergman 1987a; Kuhn *et al.* herein), this might suggest the recognition of a separate, northern facies from that in the south.
3) There well may be enough technological change from the earliest Ahmarian (*ca*. 37,000/30,000 bp) to that at 25/27,000 bp (Boker BE, Levels 2–6, and Thalab al-Buhayra C and E) to contemplate, at least, an industrial phase difference within the Early Ahmarian or, perhaps, a separate industry.
4) The Late Ahmarian does seem to be sufficiently different from the Early Ahmarian dated to before *ca*. 30,000 bp, that an industry status might be appropriate, such as the already suggested Masraqan. The problem lies with those Early Ahmarian sites dating to *ca*. 27/26,000 bp that do show technological tendencies toward Late Ahmarian status. Where to break the continuum and at what scale is the problem.

The End of the Ahmarian Industry

A rather persistent theme over the past 20 years has been the concern of just where the Upper Palaeolithic ends and the Epipalaeolithic begins. Yet, all agree (*e.g.*, Bar-Yosef 2000; Coinman herein; Gilead 1983; Goring-Morris 1995b; Goring-Morris and Belfer-Cohen 1997) that the Late Ahmarian evolved into the Epipalaeolithic. Thus, the end of the Ahmarian, as an industry, did not signal the end of the technological continuity. There are, however, no clear criteria to define this border, as ably noted by Nadel (herein).

Recognizing this continuity, it has been argued that the Epipalaeolithic is not a useful taxon and it all should be considered Upper Palaeolithic (Gilead 1984a, 1989). A comparable approach took the exact opposite position by suggesting that the Late Ahmarian be considered Epipalaeolithic (Goring-Morris 1995b). Justifying the last idea, it has been suggested that the first appearance of a retouched type, which later becomes characteristic of a period, should mark the beginning of that period. Thus, the Late Ahmarian should be considered Epipalaeolithic because of the first appearance of some typical Epipalaeolithic microliths (Nadel herein). A literal application of this would have some quite unexpected and, I would venture, unwanted and unacceptable implications. For instance, burins, which are one of the classic hallmarks of the Upper Palaeolithic, occur in good numbers and in typical form in the Tabun D-type Mousterian. Should the Tabun D-type Mousterian then be considered Upper Palaeolithic?

Another approach, using broader considerations,

recognizes the continuity in lithic technology, sees possible correlations with seasonal activities, but leaves the issue open as to when the Epipalaeolithic begins (Olszewski herein).

Since the approach taken here is technological, it is only appropriate that the end of the Ahmarian Tradition is signalled by a significant, marked change in technology. In this case, however, it is not so much of a rupture in technological patterns as a rapid simplification of basic core reduction strategies and their standardization in assemblages that otherwise are highly variable, particularly within the smaller tools classes (Bar-Yosef 1970; Goring-Morris 1995b). This marked typological proliferation has been correlated with increasing climatic fluctuations and the resulting rapid shifts in different ecological zones, which, at times, permitted exploitation of large areas, but, at other times, isolated populations from each other (Goring-Morris and Belfer-Cohen 1997). While this is a reasonable construct, Bar-Mathews and Ayalon (herein) show clearly that climatic shifts were marked and frequent throughout the Upper Palaeolithic, too, so that inconstant climate, in fact, was virtually constant. Thus, some additional factors must have been at play. While these probably had their origin in Late Ahmarian adaptations, the Epipalaeolithic is beyond the scope of this paper.

The Epipalaeolithic, however, is significant here for the very reason that it evolved out of the Late Ahmarian. The documented and undisputed Levantine technological continuity, from somewhat about 50,000 bp to about 12,000 bp, is probably the longest of any known in post-Middle Palaeolithic context.

The Levantine Aurignacian

In 1980, the Levantine Aurignacian seemed to have had a temporal span almost comparable to that of the Levantine Leptolithic Lineage, even if its geographic distribution was more limited. The materials from Ksar Akil Levels XIII/XI, (Bergman 1987a), hinted at a possible local origin for the 'classic' Levantine Aurignacian, out of a northern Early Ahmarian (Marks and Ferring 1988:64–65). Subsequent surveys and excavations in Jordan confirmed that it was rarely, if ever, to be found there, although the work at el-Kowm extended its distribution well to the northeast (Bourguignon 1998). Reconsideration of those Ksar Akil levels and of Yabrud II (Schyle 1992), however, argued that they were Ahmarian, not early Levantine Aurignacian.

In addition, both Levantine and European dating began to swing the pendulum away from the Levantine Aurignacian as the origin of all Aurignacian (Garrod 1938), to a view that the Levantine Aurignacian was intrusive into the Levant from Europe (Bar-Yosef 2000: 136; Echegaray 1978; Kozlowski 1992:13).

Given this, the duration of the Levantine Aurignacian, *sensu lato*, appears too short, and the variability encompassed too little, to qualify as a lineage. One view (Bar-Yosef 2000) would have the Levantine Aurignacian date from 36,000 bp to 27,000 bp. Yet, there are dates of *ca*. 17,500 bp from the indisputably Levantine Aurignacian site of Ein Aqev (Marks 1976b); from Fazael IX at almost 18,000 bp; from Boker BE Level 1, dated to 25,600 bp; and even Boker C, which on stratigraphic grounds must post-date 25,600 bp (Marks 1983b:37), among others. All of these suggest the Levantine Aurignacian lasted later than 26,000 bp. Of course, it depends upon whether or not the post-27,000 bp sites are Levantine Aurignacian and that depends upon how the Levantine Aurignacian is defined.

There is reason to question the proposed beginning date of 36,000 bp that is based on a small series from Kebara Cave, Unit II (Bar-Yosef *et al.* 1996). These range from 42,800±4,800 bp to 33,920±690 bp. While the oldest date is considered 'an outlier' (Bar-Yosef *et al.* 1996:303), there is no explanation why the second oldest date, 36,000±1,600 bp, is preferable to the three dates from intact deposits which range from 34,300±1,100 bp to 32,670± 800 bp. In fact, the later dates are in accord with all other radiocarbon dates for the Levantine Aurignacian from the northern sites of Umm el-Tlel, II1 through II2b (Bourguignon 1998), Ksar Akil (Mellars and Tixier 1989) and Hayonim D (Bar-Yosef 1991b), none of which exceeds *ca.* 34,000 bp.

If the Levantine Aurignacian did not arrive until 34,000 bp and was gone by 27,000 bp, it would be a mere 7,000 years long. Under Bar-Yosef's scenario it still would be only 9,000 years long. This is hardly comparable to the *ca*. 38,000 years for the Levantine Leptolithic Lineage. Even if the seemingly Levantine Aurignacian sites with later dates are included, the duration of the Levantine Aurignacian only increases to between 19,000 or 17,000 years, depending upon which starting date one chooses. Which duration is accepted depends not only upon rather idiosyncratic reasoning regarding acceptable *vs*. probable *vs*. possible absolute dates, but also upon just what is meant by Levantine Aurignacian. In this context I propose that it be considered an industry, in the same sense as the Ahmarian. The question is whether the Levantine Aurignacian, *sensu lato*, can be defined in technological terms in a way comparable to that of the Ahmarian, that crosscut the north/south and early/late differences perceived by Bar-Yosef and Belfer-Cohen (1996). It is suggested that, in fact, it can be so defined.

'Classic' Levantine Aurignacian Technology

Given the question of what is Levantine Aurignacian, initial focus will be on the technology of assemblages considered to be the 'original Levantine Aurignacian assemblages' from the central Levant (Belfer-Cohen and Bar-Yosef 1999:127): Ksar Akil VIII–VII (Bergman 1987a), Hayonim D (Belfer-Cohen and Bar-Yosef 1981), el-Wad D and, possibly E (Garrod and Bate 1937), el-Khiam 11c (Echegaray 1964), and Sefunim Level 8

(Ronen 1984). While not an exhaustive list, all agree that these are Levantine Aurignacian.

In spite of a number of assemblages, some quite recently published, detailed description of Levantine Aurignacian reduction strategies exists only for Ksar Akil VIII and VII (Bergman 1987a:103–113) and somewhat less for Sefunim. For Hayonim D, various classes of debitage have been enumerated, including almost 300, otherwise unmentioned, cores (Belfer-Cohen and Bar-Yosef 1981:23), but the kinds of information that permit a reconstruction of reduction strategies are totally missing. Blades are distinguished from bladelets but there is no indication of whether the bladelets come from bladelet cores or from carinated reduction. Thus, virtually all technological information from Hayonim D must be inferred from illustrations. The same applies to the much earlier publications of el-Wad (Garrod and Bate 1937) and el-Khiam (Echegaray 1964). Therefore, the following description of the reduction strategies from the 'classic' Levantine Aurignacian assemblages is tentative, at best.

Based mainly on illustrations, it appears that there were possibly four unrelated reduction strategies. Clearly, one strategy produced only flakes. This strategy involved intensive reduction of raw material, with the abandoned cores being fairly small and exhibiting multiple platforms. As noted by Bergman (1987a:103–106), the mode of detachment was by hard hammer, platform abrasion was uncommon, and flaking orientations and surfaces were opportunistically chosen. Resulting blanks, at least those unretouched, tended to be short and wide, with lengths, at one standard deviation, not exceeding 42 mm. A high percentage of flakes with cortex suggests that rather small nodules were chosen for reduction. It is likely that this reduction strategy produced the thick blanks used in the production of many retouched tools.

A second reduction strategy is represented by carination. By considering this only as a technological strategy for obtaining small, twisted bladelets, I am going beyond Williams (herein), in line with Bergman (herein). In one sense, this reduction strategy is comparable in concept to the bladelet producing strategy in the Late Ahmarian: blanks produced by one reduction strategy were used as cores for the production of even smaller elements by another reduction strategy. Also, they both involved already existing platforms, the use of platform abrasion to prevent platform crushing, and both produced a very limited range of blanks, metrically and morphologically. In the case of carination, the blanks almost always are markedly twisted and usually distally pointed. It appears that some blanks used in carinated reduction were small chunks, rather than flakes but this cannot be quantified (Bergman 1987a:227 fig. 70:8; Echegaray 1964:45 fig. IX:2–5; Ronen 1984:237 fig.14.5:3–4).

A third reduction strategy must be inferred. Length/width scattergrams for Ksar Akil VIII (Bergman 1987a: 223–225) show a small but distinct cluster of mainly large blades, but also flakes, that fall well outside the parameters of most other pieces, seeming to average about 70 cm in length. Since the only reference to cores anywhere that might have produced blanks of this size comes from Sefunim (Ronen 1984:233), either these normally were initial removals from raw material subsequently reduced to small size, or they came from a different reduction system. Since the same Ksar Akil scattergrams show marked bimodality, it is most likely that the large blanks found there came from a separate system utilized outside of the main areas of discard. This tendency for off-site blank production can be confirmed from other types of data (Kaufman 1981, 1988, herein). This reduction strategy, by virtue of the size of its products, involved hard hammer detachment, and probably no platform abrasion (none is visible in the illustrated examples). The few core tablets are of a size that might connect them to this reduction strategy, but also could relate to early stages of a bladelet producing strategy. It also seems that the angle between the platform and the flaking surface tended to approach perpendicular, rather than be acute. Available illustrations also indicate that core reduction was mainly from single platform cores and that these cores were exploited to the extent that many of the blanks were cortex free. Whether this involved complex core pre-forming or not is unknowable, but seems unlikely if the numerous long blades with lateral cortex and flakes with medial cortex at Sefunim and other sites are typical. An occasional long crested blade has been noted and what has been called a 'heavy duty tool' from Sefunim (Ronen 1984:244 fig. 10.10:6) might better be classified as a core with a crested edge. Thus, some complex core pre-forming might have been part of this system.

A final reduction strategy seems to have been present but, perhaps, not abundant. This was a simple, single platform bladelet strategy similar to that in the Late Ahmarian, although some change of orientation cores occur, as well. As in the Late Ahmarian, these cores have acute platform angles, exhibit consistent platform abrasion and, if the few examples found are meaningful, platform rejuvenation was carried out by core tablet technique.

In short, it appears that a series of quite distinct blank forms (large blades, regular bladelets, thick stubby flakes, and very small twisted bladelets) were each produced by a different reduction strategy. This is strikingly different from the Ahmarian pattern of producing all forms of blanks from essentially one or two closely related reduction strategies.

Given the different blank forms produced by the four reduction strategies, it is expected that blanks from each would be utilized in tool production. This appears to have been the case. The flake reduction strategy and the large blade/flake strategy seemingly provided the vast majority of blanks made into tools. In the case of the former, thick and often cortex covered blanks were chosen in preference to flat blanks. While the products of the large blade/flake strategy are traditionally segregated into blade blanks *versus* flake blanks, it was probably their size that was

important, with the selection biased toward length and mass, rather than length/width ratio.

A second group of tools, virtually all *lamelles Dufour*, was produced on the small twisted bladelets derived from the carinated reduction. While many of these assemblages have few *lamelles Dufour*, their original presence is amply documented by the carinated pieces. Their relative paucity in these assemblages probably reflects both recovery techniques and the high probability that many were taken off-site (Williams herein).

While some true bladelet production took place (seen both as a few illustrated cores and some 'Ahmarian-like' tools), their numbers are very limited. Until detailed core studies are undertaken, it cannot be certain that true bladelet production, in fact, was habitual in the 'classic' Levantine Aurignacian. It may have been no more prevalent than was the occasional 'carinated' tool in the Ahmarian.

One of the major diagnostic features of the 'classic' Levantine Aurignacian is the kind of retouch used to produce and, presumably, rejuvenate tools. While burins tend to have similar 'retouch,' no matter the industry, scrapers and even retouched pieces in the Levantine Aurignacian usually exhibit stepped, scalar, or, of course, Aurignacian retouch. Endscrapers on retouched pieces (blades or flakes) tend to have either Aurignacian retouch or scalar retouch. Rarely is this retouch marginal (Ronen 1984:242 fig.14.9:3–4), although admittedly, such are rarely illustrated, even if present. In addition, backing and fine retouch are few and far between.

Levantine Aurignacian Technology Elsewhere

Given the paucity of hard information presented above, there is little basis for a detailed comparison of it with the better-defined technology of the southern Levantine sites called Levantine Aurignacian 'in its broadest sense' (Marks 1977b:20). Even comparisons with those assemblages from the central Levant, such as the Levantine Aurignacian at Nahal Ein Gev I (Bar-Yosef 1973) would be difficult, since few are described technologically. It is perhaps useful, however, to point to some obvious similarities and to wait for the current study by John Williams of all this material to finally provide extensive, consistent technological information, which might even provide data needed to resolve this problem.

The large blade/flake reduction strategy is clear at a number of late northern and southern sites (*e.g.*, Nahal Ein Gev I, Ein Aqev, D27A, D18). It is less clear at Ksar Akil VI (Bergman 1987a:240–241), and at two of the Harif Plateau sites, G11 and K9A (Larson and Marks 1977:178–179), where raw material package size may have constrained this strategy. A third site slightly to the north of G11 and K9A, Har Horesha I, follows the same pattern; only a single massive tool was reported (Belfer-Cohen and Goring-Morris 1986:54).

A carinated reduction strategy also is well attested by twisted bladelets. For instance, at G11 and K9A about 80% of all bladelets were twisted, while the percentage of twisted blades is not significantly lower (Larson and Marks 1977:176). At Ein Aqev, twisted bladelets account for *ca*. 35% of all blades/bladelets (Marks 1976b:239). As noted above, their paucity in some assemblages with carinated 'tools' in no way weakens the evidence for the presence of carination as a reduction strategy.

The basic hard hammer flake producing strategy, which appears dominant at 'classic' Levantine Aurignacian sites is certainly present at all others, although in both the northern and southern assemblages there is a proportional increase in blade/bladelet cores, relative to flake cores. Nahal Ein Gev I seems to be an exception, since flake cores dominate (Bar-Yosef 1973). Some central Negev sites (*e.g.*, Ein Aqev, D26), perhaps, because of locally abundant raw material in large packages, contain some sizeable, only moderately exploited flake cores. These suggest that the flake reduction strategy may have begun with discoidal flake removals, prior to shifting to a multiple platform strategy.

Thus, at the southern Levantine Aurignacian sites there seems to have been a tendency toward increased non-carinated blade/bladelet production, at the expense of simple flake production. Yet, this is not so marked as to change the essential technological character of the assemblages. Blank selection reflects the continued importance of non-laminar blanks in tool production, although blade tools become somewhat more important.

Retouch types at these sites, again, remain essentially Levantine Aurignacian. It is true that there are fewer really heavily retouched scrapers than in the 'classic' assemblages (with the exception of Ein Aqev). In the north, however, burins on truncation become the dominant form, while in the south, both the abundance of local raw material and, perhaps, somewhat greater residential mobility in this marginal zone may well have led to less tool production and less rejuvenation of working edges.

Given the definition of lithic industry, I can find no reason to exclude the later northern assemblages or the southern assemblages from the Levantine Aurignacian. It is possible, even likely, that both sub-regional environmental/resources differences brought about different levels of mobility that are reflected in the assemblages. This variability might be seen within a framework of distinct industrial phases and facies. It must be kept in mind that the term industry is not synonymous with the terms phase and facies. This confusion may well be at the root of most of the published disagreements.

Is it possible to place any and every assemblage into either the Levantine Leptolithic Lineage or the Levantine Aurignacian industry? If the criteria are limited to the technological parameters defined above, it should be possible. Yet, it would be foolish to claim so. There will always be aberrant assemblages.

A more serious concern is Ksar Akil, Levels XIII–XI, which have been summarized by Bergman (1987a:145)

as having '… a blade based technology with a strong Aurignacian typology.' In technological terms, this means that those levels had typical Ahmarian reduction strategies, to which was added a very significant carinated reduction component (Bergman 1987a, herein).

Almost all Ahmarian assemblages have some few artefacts that might be associated with carination, but the amounts tend to be trivial, as at Sde Divshon (Williams herein). This is not the case for these levels at Ksar Akil. In fact, it was this very 'mixture' that suggested to us that the 'classic' (evolved in our terms) Levantine Aurignacian might have developed out of an Early Ahmarian in the northern Levant (Marks and Ferring 1988:47, 64–65). Perhaps, these Ksar Akil assemblages resulted from contact between the earliest arriving Aurignacians and the local Ahmarian population.

In sum, the classification of any assemblage into the Levantine Leptolithic Lineage or the Levantine Aurignacian industry must be determined on grounds more specific than a simple flake to blade ratio, an el-Wad point or two, or the simple presence of a few 'thick nosed scrapers.' All blades and bladelets are not equal and do not necessarily reflect the same reduction strategies (Bergman herein). Most blade producing strategies are markedly different in the Levantine Leptolithic Lineage and the Levantine Aurignacian. It is those differences, along with other technological patterns, that should determine whether an assemblage fits comfortably into the one or the other, or into neither.

Out of Africa: Implications for the Levantine Upper Palaeolithic

There has been a belief, with some exceptions (*e.g*, McBurney 1967:178; Neuville 1934), that there was a basically *in situ* evolutionary development from the Middle to the Upper Palaeolithic in the Levant (Azoury 1986; Bar-Yosef and Belfer-Cohen 1988; Copeland 1970, 1975; Ewing 1947; Garrod 1951; Marks 1975, 1990, 1993; Ohnuma 1988).

Emphasis has always been placed on describing the nature of this transition in technological and typological terms (*e.g.*, Copeland 1975, 1976; Marks 1983b; or Neuville 1934, 1951 to support a non-transition). While there still is some discussion whether one or more different transitions took place (Bourguignon 1996; Copeland 2000; Marks 1983b; Sarel and Ronen herein), an underlying assumption was shared that one or more local transitions did take place.

It took a while for the Out of Africa model to directly affect Levantine Upper Palaeolithic studies. While most speculation and reinterpretation of the archaeological record focused on Europe (*e.g.*, d'Errico *et al.* 1998; Mellars and Stringer 1989; Stringer and Gamble 1993; Orschiedt and Weniger 2000), the Levant was impacted, as well.

The Levantine problem is certainly straightforward. If anatomically modern people were 'behaviourally modern' and Neanderthals were not, how could one explain the unquestionable similarity between the material culture produced by modern humans from Qafzeh and Skhul, and that produced by Neanderthals, at Kebara, for instance? As importantly, how could the technology of one develop into the technology of the other? The problem of similarities led to some rather fancy footwork, looking for profound behavioural differences that could be inferred from these similar archaeological remains (Lieberman 1998; Shea 1989), as well as to statements that material culture, such as lithic artefacts, were uninformative about these different kinds of behaviour:

> 'If you ask me, forget about the stone tools,' Ofer Bar-Yosef told me. 'They can tell you nothing. Zero. At most, they say something about how people were preparing food. But is what you do in the kitchen all of your life? Of course not' (Bar-Yosef quoted in Shreeve 1995:193).

This vigorous denial of the usefulness of the most abundant part of the Palaeolithic record, in this context, appears to have been made mute by Klein (1998) who suggested that, in spite of anatomically modern status, Africans did not become 'behaviourally modern' until about 50 ky; only then did they expand out of Africa, beyond their earlier Levantine excursion. While this premise is interesting, it is, of course, highly speculative. It did, however, provide a focus for those Levantine archaeologists enthralled with the Out of Africa model. This, however, did not solve the problem for the Levant. The early Upper Palaeolithic shows only limited and spatially restricted evidence for modern behaviour (Kuhn *et al.* herein), compared to the 'symbolic explosion' claimed for Europe, and, then, it occurs well after 50 ky. The presence of perforated shells at Early Ahmarian coastal sites in the northern Levant (Ksar Akil and Üçağızlı) and their absence in the southern Levant before *ca*. 20,000 bp needs explanation. If they are really a surrogate for modern behaviour, what might their differential geographic distribution mean?

Under the Out of Africa scenario, it is conceptually impossible to have had a technologically developmental transition from any Levantine Middle Palaeolithic to any Levantine Upper Palaeolithic, since the former was made by Levantine Neanderthals with no capacity for 'modern behaviour,' while the latter, by definition, was 'modern behaviour,' which, if Klein is correct, had to have originated in Africa. For some, the question apparently is resolved:

> if the transition from the Middle Palaeolithic technological behavior to the Upper Palaeolithic occurred in the Nile Valley, there is no point in seeking the origins of the Levantine EUP industries in the local Late Mousterian (Bar-Yosef 2000:142).

This proposition must be justified in two ways. First, a

technological disjunction between the Levantine Middle Palaeolithic and the earliest Levantine Upper Palaeolithic must be shown. Second, a technological continuity must be shown between the earliest Levantine Upper Palaeolithic and something in the Nile Valley that is more or less coeval with it. To his credit, Bar-Yosef (2000) has attempted to do both.

There is the question of how one recognizes 'modern behaviour' in the archaeological record, beyond the tautology that, if made by Neanderthals it did not result from modern behaviour but if made by *Homo sapiens sapiens*, it was modern behaviour, regardless of the archaeological record. Some of the papers in this volume deal with aspects of this problem (Chazan, Fox, Kuhn *et al*. Sarel and Ronen, and Tostevin). Some have bought into the Out of Africa model enthusiastically: some have not. While it is a new perspective, it is a powerful one. The power lies in that the interpretations are based on non-archaeological data and, once accepted (who are we to argue with real scientists?), all one has to do is manipulate the sparse and obtuse archaeological data to fit the model.

The Levantine Middle/Upper Palaeolithic Transition: Delusion or Reasonable Construct?

It is currently fashionable to suggest that even considering a possible continuity from the Middle to the Upper Palaeolithic in the Levant is a waste of time. There are, however, a number of factors in the Levantine Middle Palaeolithic that point both to long term, regional technological continuities and others to major differences between the contemporaneous Levantine and Nilotic developments (Marks 1992). These, however, are peripheral to this problem, except as they relate to the earliest claimed Levantine Upper Palaeolithic, the Emiran.

The history of the Emiran is well known, in no need of repetition here. Merely, it should be noted that for some time it was explicitly thought of as developmentally transitional (Copeland 1975; Garrod 1951, 1955). The comparable assemblages from Boker Tachtit, Levels 1 through 3, were also described as developmentally transitional (*e.g.*, Marks 1983b), as were similar materials (but lacking the Emireh Points) from Ksar Akil (Ewing 1947).

The shift away from a seamless Middle to Upper Palaeolithic transition came first with an effort to define the beginning of the Upper Palaeolithic, as opposed to the transition. Based on technological criteria, it was decided to call the largely homogeneous, unidirectional, hard hammer blade core technology of Boker Tachtit Level 4 as Initial Upper Palaeolithic (IUP) (Marks and Ferring 1988:52) and the materials below it Transitional. No major disjunction was seen; merely, the winnowing of the multiple reduction strategies in the lower levels down to a single strategy seemed as good a place as any to draw a line.

In the interim, the meaning of the IUP has become fuzzy. Kuhn *et al.* (herein), refer to the Boker Tachtit Level 4, assemblage as 'late IUP,' while Bar-Yosef (2000:130) places the same assemblage into the Ahmarian and tends to use the terms early EUP and IUP interchangeably for the Emiran (Bar-Yosef 2000:109). In both cases, however, the purpose was to remove the word 'transitional,' because it implied continuity from the local Middle Palaeolithic. This approach was followed, as well, for comparable materials from el-Kowm, where the term *intermédiaire* was used for the same reason (Boëda and Muhesen 1993:54).

I used the term transitional because I felt that there were sufficient technological similarities in the reduction strategies and the morphology of the products produced between the Boker Tachtit lower levels and the temporally late Tabun D-type Mousterian to posit probable continuity between them (*e.g.*, Marks 1983b). The serious developmental break, at that time, lay between Boker Tachtit Level 4, and the Early Ahmarian of Boker A (Marks 1977c). This gap has now been filled at a number of sites that show a steady shift from hard hammer blank detachment to a combination of hard hammer and soft hammer (Fox herein; Kuhn *et al.* herein). As discussed earlier, the Ahmarian Industry can be traced for somewhat over 20,000 years and, combined with the Emiran/IUP and the Epipalaeolithic, the Levantine Leptolithic Lineage continuity can be traced for almost 40,000 years.

Origin of the Emiran

The question is the origin of the Emiran. If it can be shown that it most likely was derived from a Levantine base, it will contradict the Out of Africa model (at least by a few hundred kilometres). On the other hand, if it can be shown that such a derivation is 'untenable,' this will make the Out of Africa scenario more likely. Tostevin (herein) makes a rather creative attempt to do the latter, while the contribution by Sarel and Ronen (herein) implicitly argues the former position.

A Local Origin?

Tracing probable origins involves demonstrating continuity of patterns but does not necessitate a virtually unbroken continuum of stratified assemblages at a single locality. In this case, the technological patterns that continue across the Middle/Upper Palaeolithic boundary are the related production of non-Levallois blades and Levallois-like points in both the Tabun D-type Mousterian (Marks and Monigal 1995; Meignen 1995: 375; Monigal 2001) and the Emiran (Copeland 1983; Marks and Kaufman 1983). A second aspect is the continuity of true hard hammer blade production in both (Marks and Monigal 1995; Marks and Kaufman 1983; Monigal 2001). A third aspect of this continuity is the typological dominance of 'Upper Palaeolithic' retouched

tools in the southern Tabun D-type Mousterian, as well as in the Emiran (Marks 1992:235). It also should be noted that the production of triangular points, Levallois or non-Levallois, was a shared trait in all Levantine Middle Palaeolithic industries (Bar-Yosef and Meignen 1992), in the Emiran, and was still present and important in the IUP of Boker Tachtit Level 4.

This continuity of tendencies toward elongation, and the presence of *lame à crête*, emphasized by Demidenko and Usik (1993a, b), specifically has been challenged by Tostevin (herein) on the basis that, while they cited Tor Faraj and Tor Sabiha (Henry 1995a) as examples of continuity, a more recent dated example needs to be found before continuity can be proposed. While Demidenko and Usik (1993a:13) did cite those sites once, their data derived mainly from the site of Ain Difla. In that context, they wrote: 'We agree with Marks that the material from Boker Tachtit, level 1, and Ain Difla are most similar to each other' (Demidenko and Usik 1993a:6). Again, in another paper they wrote:

> 'It seems that in the industry at Ain Difla in west-central Jordan . . . the same system of 'bidirectional blade point' Levallois with the *lame à crête* technique, as seen at Boker Tachtit, existed' (Demidenko and Usik 1993b:33).

Shouldn't Tostevin (herein) have negated these observations for his argument to have validity? Since the gap between Tor Faraj, at *ca*. 69 ky (Henry 1995a:52) and Boker Tachtit Level 1 is only 20,000 years or less, this is hardly a major impediment to the continuity argument, given the rough chronological scale of absolute dating in that time frame.

Rather than deal with the details supporting continuity, Tostevin (herein) shows that the technological patterning of the Emiran at Boker Tachtit Levels 1 and 2, was 'different' from that of the 'latest Middle Palaeolithic' (Kebara VI). He concludes, therefore, that there was no continuity from the Middle to the Upper Palaeolithic in the Levant. This conclusion leads directly to the proposition that the Emiran was intrusive into the Levant: '… the regional origin of the behavioural package should be sought in adjacent localities' (Tostevin herein). This whole exercise is but a straw man. No one ever suggested that the transitional Emiran technology developed out of the Tabun B-type Mousterian. Rather, it was posited that it developed out of a temporally late Tabun D-type 'modified' technology (*e.g*., Marks 1981c). No direct continuity was claimed between the Rosh Ein Mor technology and that at Boker Tachtit. In fact, I wrote:

> 'This argument does *not* support the position that the transitional assemblages developed directly out of the presently known Early Levantine Mousterian. The specialized Levallois method found in the lower two levels of Boker Tachtit (Marks 1977b) has no direct parallel in any of the studied Early Levantine Mousterian assemblages' (Marks 1981c:290–291, emphasis in original).

I went on to speculate that the Boker Tachtit technology developed out of one '… considerably modified from that now known' (Marks 1981c:291). For this scenario to be reasonable, there had to have been a late, modified Tabun D-type technology from which the early Boker Tachtit technology could have developed. Without such, there would be no possibility of any continuity.

If the stratigraphic sequence in the Core Mediterranean zone (*e.g*., Tabun) is valid for the whole of the Levant, as Tostevin (herein) and Bar-Yosef (2000) seem to believe, then no continuity is possible. Within the Core Mediterranean zone, Tabun D has been dated by TL at about 200 ky or a bit before and to somewhat later by ESR (Bar-Yosef 1998b). These dates of about 200 ky have been confirmed within the Core Mediterranean zone by dates on other Tabun D-type assemblages (Valladas *et al*. 1998). In fact, the Tabun D-type assemblage at Rosh Ein Mor in the central Negev has recently been U-series dated to 200 ky, as well (Schwarcz personal communication). This indicates quite clearly that Tabun D-type assemblages were in both the Core Mediterranean zone and in the Negev at about 200 ky.

In the Core Mediterranean zone, Tabun D-type assemblages were replaced at about 150 ky by Tabun C-type assemblages which, in turn, were replaced by Tabun B-type assemblages at less than 100 ky (Bar-Yosef 1998b). These Tabun B-type assemblages lasted until about 50 ky when they, too, disappeared. It is a nice sequence, but not one that can be confirmed in the marginal zones of the Levant.

One line of negative evidence is site distributions. While the Tabun D-type Mousterian is found all over the Levant at 200 ky, the later Tabun C and B types are largely restricted to the Core Mediterranean zone and to the northern Levant. A few technologically atypical Tabun B-type outliers are known in that part of the Mediterranean zone that extends along the Jordanian Plateau to the south; WHS 621 (Potter 1993), and, possibly, Tor Faraj and Tor Sabiha (Henry 1995a). Only Fara II is in the environmentally marginal Beersheva Plain and it seems to have been classified as Tabun B-type more because of a late absolute date than because of its technology (Gilead 1995b). If the presently known site distributions are representative of actual site distributions and all Tabun D-type assemblages really do date well before 150 ky, then most of the marginal zones of the Levant, most of the Levant itself, essentially would have been devoid of occupation for at least 100,000 years. It is possible, but unlikely.

More direct evidence that the Tabun sequence is not valid in the marginal zones lies at two sites dated to well after 200 ky. One involves the U-Series dating of travertines from a fossil spring adjacent to the Tabun D-type Mousterian site of Nahal Aqev. The spring had three

travertines, the youngest of which had at least one typical Tabun D-type, elongated Levallois point embedded in it. While that layer could not be dated, Layer D, *underlying* the Mousterian travertine, provided two dates: 85.2±10 ky and 74±5 ky (Schwarcz *et al.* 1979). This dates the Tabun D-type Mousterian at the adjacent site (Munday 1977) to younger than *ca.* 80 ky. (Even if it is assumed that it dates to the oldest, at one standard deviation of the oldest date, it is still only 95.2 ky, more than 100,000 years younger that any Tabun D-type assemblage dated in the Core Mediterranean zone.) How these dates got reinterpreted to *ca.* 160 ky in Figure 2 of Bar-Yosef (1998b:45) is unknowable.

Another site in the marginal zone of Jordan, Ain Difla, has produced a deep stratigraphic sequence, the upper portion of which has a Tabun D-type derived technology (Lindley and Clark 1987), with tendencies toward an Emiran technology in the form of typical crested blades (Demidenko and Usik 1993a:6; Monigal 2001). A large number of dates of various kinds have been obtained: the TL date at 105±15 ky is comparable to the mean ESR date of 102±12.9 ky (Clark *et al.* 1997:91). Somehow, these, too, got translated to greater than 150 ky recently (Bar-Yosef 1998b:45).

Without the reinterpretations, the dates from these two sites strongly indicate that a Tabun D-type technology was present in the marginal zones of the Levant, at least, about 100,000 years and, again, at about 120,000 years after it disappeared in the Core Mediterranean zone. Its youngest dated appearance is only 30,000 years before Boker Tachtit Level 1, and, perhaps, less. Thus, while Bar-Yosef (2000:116) holds that any proposals for the 'emergence' of the Emiran from the Tabun D-type Mousterian 'are now untenable' because of absolute dating in the Core Mediterranean zone, this may be more wishful thinking than reality.

This brief review indicates that, in spite of a small temporal gap, and not even considering Tor Faraj discussed above, there are probable technological continuities between the Tabun D-type Mousterian, through an upper Ain Difla-like technology, to the Emiran and that the question of temporal continuity is still open. Can even so much be said of the alternative propositions?

An African Emiran?

While Tostevin (herein) only mentions that the regional origin of the Emiran should be looked for in adjacent localities, including the Nile Valley, Bar-Yosef (2000: 140, 143) focuses directly on northeast Africa. Those factors that he points to as favouring an African origin of the Emiran are the following:

1) Levallois blade production at the Lower Nile valley site of Taramasa 1 was enhanced through a change in technology that '… consists of increasing the exploitable core volume by changing the core organization' and that '… this type of 'technological technique' is similar to that uncovered at Boker Tachtit' (Van Peer 1998:S126–127).
2) For this to have any significance for the origins of the Emiran, Taramasa 1 must be as old and, preferably, a bit older than Boker Tachtit. A series of absolute dates are cited (Bar-Yosef 2000:140): two C14 dates 38,100±400 bp (Taramasa 1) and 37,000±1,300 bp (Nazlet Safaha) and 9 OSL dates from Taramasa 1 (Vermeersch *et al.* 1998:480). While the C14 dates are called minimal, the OSL dates are reported as ranging from 80.4±19.0 ky to 49.8±12.2 ky (Bar-Yosef 2000:140). On this basis, it is stated that '… around 48–40 ka, the transition to an Upper Palaeolithic mode of blade production took place in the Nile Valley' (Bar-Yosef 2000:140).
3) In Libya, the earliest Dabban, an Upper Palaeolithic blade industry, may date to *ca.* 40,000±2,000 bp: actual dates are 33,100±400 bp, 28,500±800 bp and >34,000 bp from the Haua Fteah (McBurney 1967: 71) and 40,500±2000 bp from Hagfet ed Dabba (McBurney 1975:419). As such, it could be coeval with the IUP in the Levant.
4) The Dabban is reported to have 'chamfered blades' (Bar-Yosef 2000:140), a link with 'chamfered pieces' typical of the Emiran in the northern Levant. In addition, Bar-Yosef (2000:143) notes that these are also found in Egypt.

These factors seem to suggest the possibility of an African origin for the Emiran, particularly since it is also stated that those Emiran traits, such as

> 'Levallois points with a Y scar pattern, Emireh points and *chanfreins*, . . . can better be understood as attributes of the newly introduced lithic industry, conceived and originally manufactured elsewhere, in its homeland' (Bar-Yosef 2000:143).

Yet, it is also stated that the

> '… new *chaîne opératoire* in Boker Tachtit level 1, and the Emireh point as a new tool type could be interpreted as the physical evidence for colonizing foragers, who brought in the knowledge of a new core reduction strategy and, while employing it in the new land, invented an item that was not part and parcel of the original package' (Bar-Yosef 2000:143).

It is an interesting, highly speculative attempt to promote the Out of Africa scenario with a minuscule amount of data but with lively, creative rationalizations. Unfortunately, a more mundane but methodical approach undercuts what little data might suggest an African origin for the Emiran. A second look at these arguments, in the order they were presented, produces the following:

1) While the shift to increasing exploitable core volume in Egypt is the same *kind* of technological change

seen in the Levant, they are by no means comparable in their purpose or the end products produced. While each was becoming more efficient, in Egypt this efficiency was oriented to the sequenced production of unidirectionally struck *Levallois blades*, after extensive bidirectional preparation (Van Peer 1992: 35–52), whereas in the Levant, the efficiency was seen in repeated sequences of bidirectional preparation which permitted the predictable removal of *points*. It must not be forgotten that at Boker Tachtit Level 1 the by-products of point production were small blades, normally unused, while a true blade technology, using cresting, produced those blade blanks which were later made into tools (Volkman 1983:134 fig. 6–2). The point cores produced only a single used product, the points. Thus, at Boker Tachtit there were two radically different core reduction strategies, neither of which existed in Egypt at that time.

Although Nubian, Type 2, cores look as if they produced Levallois points, there are virtually no typical Y *arête*-patterned points in the Middle Palaeolithic of the Nile Valley (Marks 1968a; Van Peer 1992). In Upper and Middle Egypt 'Nubian Levallois points' have been defined that are closer to pointed Levallois blades than to Levantine Levallois points (*e.g.*, Vermeersch 2000:41, fig. 1.21: 4), while, in Nubia, there are slightly pointed, ovoid Levallois flakes. These latter are also found in the Khormusan (Marks 1968b: fig. 15a, fig. 23a), a late Middle Palaeolithic industry dated to *ca*. 55 ky (McKinney personal communication), although occasionally somewhat more typical Levallois points are found (Marks 1968b:fig. 36a, g). On the other hand, typical Levallois points are ubiquitous in the Levant during virtually all of the Middle Palaeolithic.

2) Based on the reasonable clustering of seven of the nine OSL dates, I would place the probable age of Taramasa 1 closer to 55 ky, as does Vermeersch *et al.* (1998:481), than to the 48–40 ky spread. If so, then there might well have been a rather stable technological pattern in Lower Egypt, lasting from *ca*. 55 ky to, perhaps, 40 ky or later. As importantly, this Egyptian technology does not become blade producing in any Upper Palaeolithic sense, as was the case in the Levant. The first real blade technology in Lower Egypt is well dated to only 35,000 bp and is associated with a developed bifacial technology of very African character (Van Peer 1998:S129).

3) The Dabban does truly have an early Upper Palaeolithic blade technology. It also has chamfered pieces comparable to those from the northern Levantine Emiran, as noted in relation to the Levant almost 30 years ago (Marks 1975:450). Unfortunately, the similarities stop there. The blade technology includes soft hammer detachment from prismatic cores starting in the earliest Dabban levels (*e.g.*, McBurney 1967: 138), the blades themselves are small and there is a significant bladelet component, or as McBurney (1967:140) put it, '… almost microlithic blades.' There is nothing approaching Levallois or Levallois-like points and the characteristic, even dominant, retouch form is backing (McBurney 1967:135–160).

The other 'chamfered pieces' reported from Egypt (Vignard 1921), cited, perhaps, as additional evidence for their African genesis, in fact, come from a Pre-dynastic surface site which produced axes with transversely struck bits (Vignard 1957), as already pointed out over twenty-five years ago (Marks 1975:450).

It is always possible that new data will demonstrate an African origin of the Emiran. Until then, however, the possibility of a local developmental continuum should not be discarded out of hand.

A Pan-Emiran?

The technological similarities between the Emiran, as seen at Boker Tachtit, and the Bohunician have been noted for some time, as pointed out by Tostevin (herein). In fact, Tostevin's conclusion that the 'Bohunician Behavioural Package' resulted from a diffusion event, first seen in the Levant, but not originating there is essentially the same as proposed by Škrdla (1996) who suggested a migration from the Levant into central Europe. Since there was no one in central Europe to accept such a 'package' but Neanderthals, Tostevin must be using diffusion to mean migration. Thus, it is curious he never cites Škrdla.

Migration is certainly a historic possibility. As far as central and eastern Europe is concerned, however, it would have been a migration into oblivion. Virtually all knowledgeable in the area (*e.g.*, Allsworth-Jones 1990; Kozlowski 1988:15; Kozlowski and Otte 2000) see no issue springing out of the Bohunician in Europe. Is it not surprising, therefore, that it is only in the Levant, the first stop on the long road north, where the Emiran, in fact, did lay the seeds for the local Upper Palaeolithic?

The Bohunician and the assemblages from Boker Tachtit, in fact, are quite similar, as has been noted both by people working in central Europe (cited by Tostevin herein) and by some working primarily in the Levant (Marks 1993). Again, surely no one is surprised by his conclusion that the Bohunician/Emiran is different from the Aurignacian. The intra-group similarities and the inter-group differences are extremely robust: it would be difficult to find even five independent 'behavioural domains' from each that would suggest otherwise. Not without reason have the Aurignacian and the Bohunician been considered unrelated, since the first Bohunician assemblage was described. As might be noted, I am unconvinced that the assumptions and methodology used by Tostevin (herein) have provided new insights: they have merely made the obvious look complicated and original.

Any study of the sort done by Tostevin is fraught with potential problems. Why should the assemblages used be thought of as characteristic of the group of assemblages that make up the whole (*e.g.*, why is the central European Aurignacian represented by two assemblages and the Levantine by only one)? Is it so clear that there are no significant variations among the Aurignacian, even within his terms? How accurately and consistently have the observations been made? Are the categories of information, the 'behavioural domains,' actually independent and what of the 'knapping steps'? Does anyone really believe that the average width/thickness ratio of all debitage and tools within an assemblage '… quantifies the volumetric conception (*sensu* Boëda 1994)' (Tostevin herein, Table 6.1)? One could go on and on.

Even if all Tostevin's theoretical and methodological assumptions were accepted, there is the problem of getting the observations right. In the case of Boker Tachtit I (Tostevin herein, Table 6.2), the direction of Blank Removal is described as 'Bidirectional changing to Unidirectional,' while the Direction of Cortex Removal is called Unidirectional. Boker Tachtit Level 1, with its extensive core reconstructions (Volkman 1983), is one of those assemblages where it should be virtually impossible to get it wrong. Yet, Tostevin managed to do so. As Tables 6–1 and 6–2 in Volkman (1983:133, 136) clearly show, the discarded cores were almost wholly bidirectional, and after reconstruction there was not a single core that could be classified as unidirectional. There was a single unidirectional reduction, missing the core (Volkman 1983: 134 fig. 6–2), but there was no indication that this core, with its crested preparation, was ever bidirectional. The direction of cortex removal is explicitly described by Volkman (1983:137–138) and it is multi-directional, not unidirectional, as claimed by Tostevin. I know Boker Tachtit. How much faith should I have in those characterizations of assemblages I do not know? I wonder how the 'assemblages' thought of as being transitional by Sarel and Ronen (herein) would have come out using Tostevin's methodology? It seems to me that Levantine Upper Palaeolithic studies need, above all, a rigor in conception and methodology. I do not believe that Tostevin's efforts, creative as they may be, add to that rigor.

Final Thoughts

As pointed out by Anna Belfer-Cohen and Nigel Goring-Morris at the beginning of the symposium that ultimately became this volume, the 1987 London meeting failed to move us to a common consensus and/or common definitions for studying the Levantine Upper Palaeolithic. Without at least a commonly understood vocabulary, we cannot even communicate with each other meaningfully. This is reflected in so many publications over the past twenty years and over almost all aspects of Upper Palaeolithic concerns, from its origins to its end. It is time to develop that vocabulary. Whether or not the specific proposals and definitions put forth in this paper are accepted is not important. If they can serve as a base from which to arrive at other, clearer concepts and definitions, it is fine with me. Let us do it.

22. Reflections on Selected Issues of the Upper Palaeolithic

Ofer Bar-Yosef

Introduction

The common goals of Palaeolithic archaeology are to address issues of stratigraphy, chronology, and cultural entities, beginning with the analysis of lithic and bone assemblages, and peaking with the coarse-grained paintings of prehistoric life ways. Within this framework, modern research stresses the necessity of conducting regional investigations aimed at establishing local sequences. This is what the papers in this volume are all about. The period under consideration is the Upper Palaeolithic, a term coined in western Europe, the homeland of our discipline. It seems to me that currently there is very little room for presenting additional data or discussing particularities. Rather, I would like to examine the Upper Palaeolithic phenomenon from a broader perspective. Adopting a wide-angle view may assist us in placing what is recorded and so well presented in this volume within a comprehensive, global scope.

The issues to be discussed below are those pertaining to questions such as:

(a) is the transition to the Upper Palaeolithic a major evolutionary event of global proportions;
(b) was the impetus for the transition to the Upper Palaeolithic a biological and/or cultural change;
(c) what could have been the meaning of the operational sequences (*châines opératoires*) within a particular time trajectory;
(d) what possible palaeodemographic implications derive from the studies of operational sequences in the Middle and Upper Palaeolithic?

The Nature of Cultural Transition

During the evolution of humankind we see specific times when economic, political and technological changes occurred rapidly. Although scholars disagree on the number of major cultural changes required to merit the label 'revolution', there is little doubt that the transition from the Middle to the Upper Palaeolithic, the Neolithic transformation of foraging to farming, the Industrial Revolution of the 18th century, and the Communications Revolution of the 20th century should all be labelled as such.

We generally evaluate revolutions on the basis of their outcome. We can easily find, as in every scholarly debate, gradualists who would interpret the most dramatic cultural and socio-economic changes as slow incremental processes lasting hundreds or even thousands of years. Adherents to the idea of gradient change identify a long period during which certain elements (social, symbolic, technological and the like) accumulated, which, *a posteriori*, will be seen as 'preparatory' for the actual transition.

In contrast, scholars who view a major technological and or/socio-economic change as radical and rapid will focus more specifically on 'when' and 'where' it occurred. Successful completion of the first phase of such a critical transformation will culminate in 'a point of no return'. The catalytic change or series of changes would often result in the emergence of new social and economic systems, leading expectedly to shifts in ideology. It is possible to observe how the re-designed belief systems accommodate the 'new regime'. The ideological modifications are commonly initiated by powerful shamans, priests and, more recently, by political and religious leaders, and these modifications would find their expression first in public gatherings, and only later in the domestic arena, which is generally more conservative. As archaeologists we can evaluate and interpret each of these 'revolutions' only when their outcome is reflected in the material world, which may only occur a century or more after the socio-economic transformation.

The advantage of historical studies is that scholars can geographically and chronologically pinpoint when and where a revolution began. For instance, historical documents and archaeological remains record the 'when' and 'where' of the Industrial Revolution in 18th century England, how quickly technical inventions were transported to other regions, and when and how social changes occurred (*e.g.*, Landes 1969, 1998; Wolf 1982; Goldstone in press). However, reaching agreement among historians

and anthropologists concerning the 'why' question is more difficult, even in the case of the Industrial Revolution. The lesson for archaeologists who study the prehistoric past that leaves no trace of names for social units and their chiefs, is that the 'when' and 'where' should be our first concern, while answers to the 'why' question will remain elusive and open to constant debates and re-interpretations.

For example, it is difficult, in spite of the rapidly accumulating data, to be specific about the 'when' and the 'where' of the Neolithic Revolution during the Terminal Pleistocene-Early Holocene. Even when the time-scale is based on dendro-calibrated chronology, the error margins of the dates preclude reconstruction of historical events *per se*. Given the current level of knowledge, we must recognize the generic limitations of the archaeological records as well as the time determinations produced by the best laboratories.

The notion of 'core' and 'periphery' was borrowed from the study of historical periods, but used only as geographic definitions (Bar-Yosef and Belfer-Cohen 1989). Innovations or inventions often appear first in a 'core' area and then spread elsewhere. However, the Lower Palaeolithic record provides some serious warnings against these assumptions. It is generally suggested that during the Lower and Middle Pleistocene, the long-distance human dispersals can be shown by the geographic distribution of a given lithic operational sequence (Rolland 1996, 1998). This notion is derived from the extrapolated evidence for the spread of early hominids across extensive landmasses over long time-spans. None of these movements, as the gaps in the archaeological records indicate, ensured the survival of the new immigrants or colonisers. Extinction of lineages and/or populations is recently being considered by archaeologists (*e.g.*, Bar-Yosef 1998c; Bar-Yosef and Belfer-Cohen 2001), and is supported by the biological evidence for 'bottlenecks' (Harpending *et al.* 1998). Hence, if the biological continuity of human populations over large geographic distances and variable ecological zones cannot be demonstrated, we need to accept as a viable hypothesis that certain tool making techniques were invented independently at different times and different places during the Lower and Middle Pleistocene (Fig. 22.1). Such cases would be the independent inventions of the bifaces (*e.g.*, Villa 2001) and the basic blade techniques (*e.g.*, Bar-Yosef and Kuhn 1999). Nevertheless, it is possible that in the future, with further improvements in radiometric techniques, continuity in time and space during the late Middle Pleistocene and the Upper Pleistocene, of a particular lithic technique or way of shaping bone and antler objects may be recognized as reflecting the movements of people.

Indeed, the genetic evidence in Europe and the Mediterranean basin suggests long distance dispersals, thus the rapid spread of *Homo sapiens sapiens* is viewed as marking the onset of the Upper Palaeolithic. However, before discussing the regions that clearly display markers of the transition (Europe, northern Asia, and north Africa), and areas in which the transition is not well-recorded or simply did not occur (southeast Asia and sub-Saharan Africa), we need to enumerate the attributes of the Upper Palaeolithic revolution.

The Characteristics of the Upper Palaeolithic Revolution

The literature is equivocal about the reasons we observe certain cultural and biological differences between the Middle and the Upper Palaeolithic. Generally, the currently available evidence is derived from Eurasia, with much less from Africa. On the whole, with some exceptions, Upper Palaeolithic contexts are characterized by the more or less consistent appearance of the following traits (*e.g.*, White 1982; Gilman 1984; Klein 1995a, 1999).

a. Systematic production of prismatic blades with rare occurrences of entities where flake production is dominant.
b. Regional and relatively rapid shifts (within hundreds or a few thousand years) in artefact design, which are interpreted as reflecting stylistic variability.
c. Long-distance exchange networks of lithics and other raw materials ranging over several hundred kilometres.
d. Improved hunting tools such as spear-throwers, the eventual invention of bows and arrows, and boomerangs.
e. Clearer intra-site spatial organisation within habitations and hunting stations, determined by functional needs (storage facilities, kitchen area, sleeping grounds, and the like).
f. Systematic production of bone and antler artefacts for daily and ritual uses.
g. Systematic use of body decorations such as marine shells, tooth pendants, *etc*.
h. Mobile imagery (human and animal figurines), decorated and carved bone, antler, ivory and stone objects.
i. Representational and abstract images and signs, whether painted, engraved or both in caves and rockshelters, as well as on exposed rock surfaces.

This array of achievements reflects not only technological innovations but also the unique characteristics of each regional archaeological culture. Moreover, it is neatly demonstrated by the so-called 'creative explosion' that essentially denotes populations in western Europe, and in particular the Franco-Cantabrian interaction sphere (Bahn and Vertut 1988). In spite of the contemporaneity of Upper Palaeolithic artistic manifestations with other *Homo sapiens sapiens* populations, no similar florescence of rock art is found in other regions, including those with karstic caves where foragers survived for longer periods such as the western Caucasus (*e.g.,* Liubin 1989).

We should keep in mind that some of these tools,

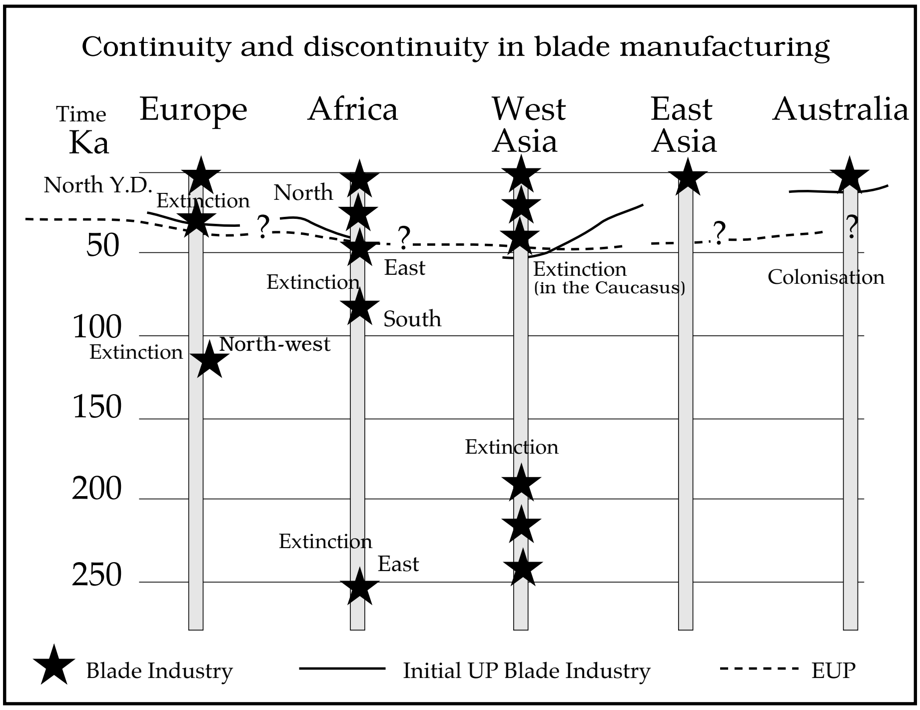

Fig. 22.1 Suggested population extinctions between different periods of blade manufacture.

techniques, and behaviours – often considered as characteristics of *Homo sapiens sapiens* – are known from various sites of Middle Palaeolithic age. For example a rich bone tool assemblage was uncovered in the Middle Stone Age Bloombos cave in South Africa (Henshilwood *et al.* 2001), or late Neanderthal contexts such as Arcy sur-Cure (Zilhão and d'Errico 1999). Red ochre was reported from numerous Middle Stone Age and Mousterian sites (McBrearty and Brooks 2000; Mellars 1996a, b; Henshilwood and Sealy 1997; Hovers 1997; Wreschner 1976). Intentional burials were practiced in Mousterian contexts in the Levant since the Last Interglacial (Belfer-Cohen and Hovers 1992). The point to be stressed is that several traits, such as blade production, selective collection of marine shells, and the making of bone tools, appear as irregular phenomena during the late Lower and Middle Palaeolithic (*e.g.*, Moloney 1998). They became regular cultural components of the Initial Upper Palaeolithic, after *ca.* 45 ky (Kuhn and Stiner 2001; Ambrose 1998b).

Explanations for the Middle to Upper Palaeolithic transition have remained static during the last century and a half. Most prehistorians view the European sequence as *the* model, and the appearance of the Cro-Magnons as determining the fate of the Neanderthals. In recent decades, gradualists have suggested a smoother transition triggered by human adaptations to variable environments (*e.g.*, Clark and Lindly 1989). Others, with the emerging evidence from genetic studies, have preferred full or partial replacement (*e.g.*, Stringer and Gamble 1993). It was further suggested that modern *Homo sapiens* capacities are related to a neurological mutation some 50 ky ago (Klein 1995a). An additional matter to consider has been the discovery that the Chatelperronian (with bone tools, pendants, and blade industry), originally thought of as an Upper Palaeolithic entity, was probably produced by Neanderthals. It was suggested that this phenomenon resulted from a process of acculturation (Mellars 1989). Criticism of this interpretation was based on the fact that the radiocarbon dates, when placed on a geographic trajectory from east to west across Europe, do not support the idea of interaction between the incoming Cro-Magnons and the local late Neanderthals (Zilhão and d'Errico 1999). According to these scholars, the early Aurignacian dates which indicate the contemporaneity between the Chatelperronian and the Aurignacian should be rejected on the basis of careful analysis. Another view of the issue regards this transition as triggered by technological innovations and inventions in a particular core area, as with other revolutions (Bar-Yosef 1998a). The rivalry between the Neanderthals and the incoming Cro-Magnons is seen as competition between two populations (Bocquet-Appel and Demars 2000). The processes and results are described elsewhere (Bar-Yosef 2000). However, the debate on the causes for the Middle to Upper Palaeolithic transition continues.

At the same time we are witnessing the further accumulation of data sets as additional sites are excavated across Eurasia (*e.g.*, Derevianko *et al.* 2000). The colonisation of Australia, some 60 ky ago, was accompanied by but a few Upper Palaeolithic cultural traits (Thorne *et al.* 1999; Stringer 1999). In Tasmania, Upper Palaeolithic

assemblages comprise simple core and flake industries, yet are supplemented by bone tools (Jones 1995). However, a more striking challenge to the Eurocentric model comes from two other regions – southeast Asia and sub-Saharan Africa.

East Asia and Sub-Saharan Africa: Do They Conform to the Model?

We know that southeast Asia produced an entirely different Palaeolithic sequence than that in most of Eurasia and Africa. The lithic sequences of this vast region mostly reflect the production of core and flake assemblages, with only the rare appearance of Acheulian assemblages during the Lower/Middle Pleistocene (Huang and Wang 1995; Hou *et al.* 2000). The Upper Pleistocene core and flake industry is known in southeast Asia as the Hoabinian (Allchin 1966) and the only markers that indicate a change during the 'Upper Palaeolithic' are the bone tools which are missing from earlier contexts (*e.g.*, MacNeish 1996). Overall, the cultural attributes of the Upper Palaeolithic in western and northern Eurasia as reflected in the stone, bone and antler industries are not found in southeast Asia. The geographic boundary between these two major cultural provinces is the Qinling range of mountains in China. This east-west chain separates the Yangzi River basin in the south from the northern Yellow River basin. It is only in the latter that microblade industries, which spread from western Asia through Siberia and later into the New World, are well-documented (Olsen 1987; Chun and Xiang-Qian 1989; Goebel *et al.* 2000; Brantingham *et al*. 2001; Lu 1998). We may therefore be puzzled by the genetic evidence, which indicates a more or less Upper Palaeolithic age for the Chinese population as a whole (Piazza 1998). Does this mean that present-day Chinese populations derive solely from Upper Palaeolithic groups inhabiting northern China?

The idea that the tropical zone, such as southern China, is an optimal ecological niche for stragglers, relict species that survive there beyond other members of their genus, is not foreign to prehistoric research. For example, the suggested late dates for *Homo erectus* in Indonesia and their apparent contemporaneity with archaic modern humans, is well known (Swisher *et al.* 1996). Similarly, the survival of populations in mountainous areas is documented by cases of late Neanderthals in Iberia, the Caucasus and Crimea (Bar-Yosef and Pilbeam 2000). On the whole, the contemporaneity between different Palaeolithic entities or 'cultures' is a worldwide phenomenon. In several cases, the bearers of one culture could have been more aggressive and successful than their neighbours. Competition over resources could have led to the extinction of particular populations. Only further research in southeast Asia may clarify the socio-economic processes and their ecological contexts, which encouraged the conservatism in the manufacture of stone tools as a most advantageous strategy during local Upper Palaeolithic times.

A different picture emerges in Africa. The current survey of the sub-Saharan Middle and Upper Palaeolithic (known locally as Middle Stone Age (MSA) and Late Stone Age (LSA) suggests that there is no evidence for an Upper Palaeolithic 'revolution', such as that conceived in Europe, western and northern Asia (*e.g.*, Deacon and Deacon 1999; McBrearty and Brooks 2000). This claim is essentially based on the gradual appearance of various Upper Palaeolithic markers across Africa (McBrearty and Brooks 2000). In particular, McBrearty and Brooks stress the early manifestation of bone tools, use of red ochre, appearance of beads and the like. The limited geographic distribution of cave art and its absence from regions such as north Africa, the Near East or Siberia, has not hindered the attribution of archaeological contexts to the Upper Palaeolithic. Interestingly, most of these modern behavioural attributes already appear in Africa during the 'Last Interglacial'. Assigning ages in the range of 150/130 ky for the gradual accumulation of modern behavioural expressions concurs with those indicated by nuclear and molecular genetic data for the emergence of modern humans (Harpending *et al.* 1998; Underhill *et al.* 2001). Without delving into the issue of biological evolution, the processes described by McBrearty and Brooks, mainly from sub-Saharan Africa, support the notion of a long 'brewing' interval needed by Modern Humans to prepare for the Upper Palaeolithic Revolution (Bar-Yosef 1998a).

One major point stressed by scholars relates to the kind and type of stone tools made by humans. During the timespan known as the Initial Upper Palaeolithic, lithic assemblages underwent either major or minor changes (depending on the researcher's preferred paradigms). Hence, it would be seem appropriate to examine the ways in which we study and interpret stone artefacts.

*Operational Sequence (***Chaîne Opératoire***): Why Bother?*

The search, either explicit or implicit, into the minds of prehistoric knappers seems today as one of the most informative and meaningful ways of conducting lithic analysis. The concept was derived from the work of Leroi-Gourhan (Audouze 1999), studies by R. Cresswell (1982, 1992), and others (such as P. Lemonnier 1992), and were integrated by French prehistorians' lithic analysis (*e.g.*, Pigeot 1990, 1991; Boëda 1988b, 1995a; Boëda *et al.* 1990; Géneste 1985; Sellet 1993; Inizan *et al.* 1999). This method of analysing lithic assemblages, whether based on refitting or simple 'reading' of the scar patterns, was adopted by others elsewhere in Europe and the Near East (Van Peer 1992, 1995; Bar-Yosef and Meignen 1992; Meignen 1995, 1998b; Sellet 1995; Schlanger 1995b; Kerry 2000). However, the best way to study the sequence of knapping decisions executed by the prehistoric knapper is to analyse each step apparent in a refitted core (*e.g.* Volkman 1983; Goring-Morris *et al.* 1998; Schlanger 1995b). The desired blanks, identified by the archae-

ologist, are those that bear secondary modification (by retouch) or signs of utilisation revealed through microwear analysis. These blanks reflect the initial aims of the artisan and his/her decision as to which blanks are the appropriate pieces for use.

Studying and classifying the operational sequences, when refitting was not conducted due to lack of funds, incompleteness of the studied assemblage, or simply due to the condition of the artefacts, is not an easy task. Frequently, researchers attribute considerable importance to the study of the discarded cores. However, the scar patterns of an exhausted core, when compared with the primary post-decortication blanks, reflect changes in the sequence of the knapper's actions. For example, it may happen that a 'unidirectional recurrent Levallois core' was modified into a 'centripetal' (also called a 'radial') one in its final stages of exploitation. Another example would be blade cores known as 'crossed', changed orientation or 'at ninety degrees', when one surface from which blades were removed is perpendicular to the second surface.

The trouble with drawing conclusions from the discarded cores is that it is impossible to know whether the change in the procedure for flake or blade removals was implemented by the original knapper or by someone else. Identifying the individual knapper is a problem that is rarely addressed (though see Ploux 1991). Often, archaeologists assume that the same knapper used a particular core from the beginning to its final, exhausted stage, as seen today in the archaeological record. However, this assumption is not warranted. We need, in the course of investigating a lithic assemblage, to ask ourselves who was responsible for the exploitation of the discarded cores. I am fully aware that this is not an easy question to answer. One way of testing the option that more than one person was involved in the process of core reduction is when the evidence for the use of the core comes from refitted blanks that were collected from two or more spatially separated concentrations. Faced with this kind of evidence we may conclude that either a single individual carried out spatially and temporally different knapping sessions, or that different knappers used the same core during its life history. It is appropriate, in this context, to raise the possibility that before cores became fully exhausted they may have been used in practice sessions, when one knapper taught another, in particular while teaching younger members of the group. Additionally, imitators such as small children playing games could have picked up the discarded cores or thick flakes that adult knappers would consider to be unusable, and practice without supervision.

In sum, given the degree of intra-site and/or intra-assemblage variability, the identification of the *chaîne opératoire* should, in my view, be based solely on the first series of blanks removed. I suggest assigning only secondary value, if at all, to the categorisation of the discarded cores. The final forms of the cores should be regarded as simple cases of equifinality, unless they conform to the original design of blank reduction. For example, the proliferation of centripetal scar patterns on discarded cores in an assemblage where most larger and primary blanks indicate 'recurrent Levallois' may simply mean that the cores were used for teaching or for the expedient extraction of small flakes. A similar example, as mentioned above, among Upper Palaeolithic assemblages, is when prismatic cores become in their final phase (sometimes after a change in the direction of blade removals to create those types known as 'crossed striking platforms' or 'at 90 degrees') a source for small flakes or bladelets (*e.g.,* Bar-Yosef and Belfer 1977).

Time Trajectories and the Chaîne Opératoire

Studies of the *chaîne opératoire* in every prehistoric period also should be required to address two crucial issues: (1) What meaning can we derive from essentially the same *chaîne opératoire* being employed for extended periods on the order of 40–50,000 years and even more (*e.g.,* Bar-Yosef 2000)? And (2) why, if that *chaîne opératoire* is optimal, do we suddenly witness change? Each of these questions is exemplified by several archaeological cases, beginning with the late Middle Palaeolithic.

The documented *chaînes opératoires* of Levantine Middle Palaeolithic assemblages served, until recently, as the basis for clustering assemblages into industrial groups (*e.g.,* Bar-Yosef and Meignen 1992; Meignen 1995; Meignen and Bar-Yosef 1991). This is not to say, as stressed elsewhere (Bar-Yosef 1998b, 2000) that some variability does not exist between these Mousterian assemblages. The remarkable similarity of assemblages, such as Tabun B, Geula, Kebara, Amud, and Tor Faraj was noted and the assemblages were clustered under the temporary term 'Tabun B-type' industry (Bar-Yosef 2000). One example of minor changes is the difference between units XII–IX and VII–VIII in Kebara. The frequencies of blades increase and the triangular Levallois points decrease in the upper units (Meignen and Bar-Yosef 1991; Meignen *et al.* 1998). However, through the entire sequence the 'convergent recurrent Levallois method' remains the dominant method of obtaining blanks. Similar cases are documented in the course of comparisons between Amud, Tor Faraj, and Kebara (*e.g.,* Henry 1995d, 1998; Hovers 1998).

The trouble is that the sources of the observable variability are not easily explained. It is possible that the 'devil is in the details', but what does it mean? We do not have the terms of reference that are required in order to provide a palaeo-anthropological interpretation for the observed variability. Under these circumstances the most parsimonious explanation, in my view, is the one suggested above, namely that the variability was the expression of the individual abilities and capacities within a given, rather rigid system of teaching. The common opinion among researchers of Middle Palaeolithic assemblages is that the prehistoric knappers had comprehensive knowledge of all of the available methods and techniques.

Following this argument, knappers must have made choices about tools as they enjoyed or suffered living in different environments. As a reminder for the researcher, the large body of Middle Palaeolithic technical information incorporates the various Levallois and non-Levallois methods as described and defined by Boëda and others (Boëda *et al.* 1990; Boëda 1995a; Van Peer 1992). The assumption that Middle Palaeolithic knappers mastered this entire array of Levallois and non-Levallois techniques remains unproven. Unfortunately, the specific 'life histories' of refitted cores or the reconstructed *châines opératoires*, cannot be attributed to particular individuals. Our desire to trace the role of the human agent is legitimate, yet the task seems to be more facile to achieve under 'Pompei premise' conditions (Binford 1981), *i.e.*, in sites where living floors were covered soon after abandonment. However, when 'living floors' accumulate and create a palimpsest, as demonstrated by the thick accumulations exposed in the Levantine caves, the clustered assemblages represent long-term tendencies in the use of one particular (rarely two) methods of knapping.

I have mentioned elsewhere the variable rates of deposition in sites such as Kebara and Hayonim caves (Bar-Yosef 1998b, 2000). In Kebara, one cubic metre produced 1,000 or more pieces (longer than 2.5 cm) accumulated over *ca*. 3,000 TL years. In Hayonim, the same volume with 300 or less pieces accumulated during *ca*. 10,000 TL years. At Kebara the rare microfauna indicate a more or less constant human presence and thus the almost complete absence of barn owls, in contrast to the reverse situation at Hayonim. The interpretation, besides differences in relative group mobilities and thus in settlement patterns, as well as demographic densities (Stiner *et al.* 1999; Hovers 2001), is that the same one or two *châines opératoires* were practiced for a very long time (Meignen 1995, 1998b). Hence we may conclude that rigid teaching and transfer of knowledge within a closed society persisted over the course of many generations among Middle Palaeolithic groups. This picture differs markedly when we examine Upper Palaeolithic contexts and industries across Europe, western and northern Asia and North Africa (Fig. 22.2).

Retouched Pieces as 'Guide Fossils'

In the course of changing approaches towards lithic analysis during the last two or three decades, I believe the significance of the retouched pieces, traditionally called 'tools' receded and sometimes was even ignored. Studies of operational sequences focus primarily on the blanks that were selected for use, and no special attention is given to secondary retouch. Yet, classification of retouched pieces is a critical aspect of archaeological investigation and, at least during the Upper Palaeolithic, it clearly demonstrates that, while the *châine opératoire* changes very slowly through time, shifts in tool forms are more rapid (*e.g.,* Goring-Morris *et al.* 1998).

On this issue a brief historical reminder is necessary. Abbé H. Breuil was the scholar who in 1913 published the first synthesis of the Western European Upper Palaeolithic. His scheme, which left an indelible terminological impact, was based on the stratigraphy of French sites and differences in tool types (Breuil 1913). The earliest, immediately post-Mousterian entity, with Chatelperronian knives, was named 'Lower Aurignacian' followed by 'Middle Aurignacian' and 'Upper Aurignacian' with Gravettian points. The later entities were the Solutrean and the Magdalenian. In the 1930s, D. Peyrony, a local enthusiastic prehistorian in the Perigord, suggested renaming the 'Early Aurignacian' and the 'Late Aurignacian' as Perigordian I–V, because they were all blade dominated assemblages with backed points. In the English language literature the 'Early Aurignacian' was called the 'Chatelperronian' (today also known as 'Castelperronian') due to the presence of curved backed Chatelperronian knives (Bordes 1968b). The 'Middle Aurignacian' retained the appellation of the 'Aurignacian Culture', characterised by carinated and nosed scrapers and a rich bone and antler industry. The 'Late Aurignacian' was called Perigordian IV by Peyrony, but the term 'Gravettian', after the straight-backed Gravette points, finally gained acceptance (*e.g.*, Coles and Higgs 1969). The scheme of Peyrony, except for the separation of the Aurignacian into a different culture or cultural tradition, did not survive the introduction of radiometric dating and re-analysis of the local lithic assemblages in western Europe. A return to the basic definitions of independent entities is accepted as the rule of the day (*e.g.,* Gamble 1986; Collins 1986; Djindjian *et al.* 1999).

Only one notion has remained deeply embedded in the literature, namely that the Chatelperronian is an Upper Palaeolithic entity representing the cultural 'transition' from the Middle to the Upper Palaeolithic. As predicted by F. Bordes (1972), although he himself had difficulties accepting the corresponding biological implications, the Chatelperronian had its roots in the late Mousterian of Acheulian Tradition, which according to the fossil record was the creation of local Neanderthals. The discovery of Neanderthal remains in a Chatelperronian layer in St. Césaire provided the hard evidence for biological continuity accompanied by cultural change amongst a single population (Lévêque and Vandermeersch 1981). Indeed, the Upper Palaeolithic traits of the Chatelperronian (the production of blades and curved backed blades) which were documented by J. Pelegrin (Pelegrin 1990a, b; Lévêque *et al.* 1993), are instructive: a) the term 'transitional industry' can have biological as well as cultural implications; and b) the blades *per se* cannot serve as the sole marker for designation of the 'Upper Palaeolithic' (*e.g.,* Bar-Yosef and Kuhn 1999).

The case of the French Chatelperronian, which can be matched by examples from other geographic regions, raises the question 'what is the Upper Palaeolithic?' Take, for example, the Howieson's Poort industry in South

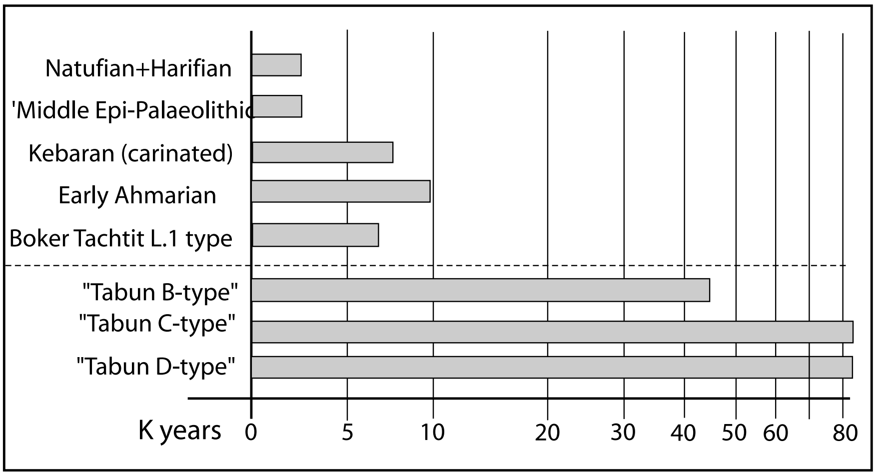

Fig. 22.2 Approximate duration of various chaînes opératoires *in the Levant based on Bar-Yosef 1998b, and Goring-Morris* et al. *1998. Note that the approximate duration is longer for the Middle Palaeolithic and shorter for the Upper Palaeolithic. Sometimes more than one* chaîne opératoire *was practiced in the course of any interval (Meignen 1995, 1998b).*

Africa (*e.g.*, Deacon 1992, 1996; Deacon and Deacon 1999; Wurz 1996, Henshilwood *et al.* 2001). This is a blade industry, currently dated to *ca*. 80–60 Ky, with a dominance of crescentic backed blade forms and bone tools, intercalated within the Middle Stone Age sequence (*e.g.*, d'Errico *et al.* 2001). Another example is the Szeletian and the Bohunician cultures in Central Europe, which are considered 'transitional industries.' The first did not produce evidence that it developed into a fully-fledged Upper Palaeolithic entity (Kozlowski 2000), while the second did not develop out of a local Mousterian, but rather is now considered intrusive into this region (*e.g.*, Svoboda and Skrdla 1995; Tostevin 2000).

It is therefore best to abandon the term 'transitional industry', which we have extensively employed over the last five decades, and call Early or Initial Upper Palaeolithic (Marks 1990) entities by local names. We can refer to an entity as 'transitional' only when it is demonstrated that the described assemblage represents a local cultural transition from the Middle to the Upper Palaeolithic. Otherwise, as shown by the above-mentioned cases, an industry with 'transitional' characteristics may rather represent processes that initially took place elsewhere. For a foreign group to establish itself in a new environment there was a need for techniques to exploit local resources, possibly with minimal or no conflict with local populations. During the Stone Age there were undoubtedly empty regions with adequate subsistence resources. The absence of people from such areas could result from stochastic dispersals as well as local extinction (through natural or violent means).

The study and interpretation of retouched pieces is no less important than the analysis of core reduction strategies. One may argue that the different forms are generally related to function and possibly influenced by the nature of available raw materials. Thirty years of microwear and edge damage studies have demonstrated that the above are not the reasons for assemblage variability during the Palaeolithic (*e.g.,* Beyries 1988, 1993; Jensen *et al.* 1991). The need for suitable sharp or blunt edges for cutting, whittling, butchering, engraving, and perforating, created the need for variable design of retouched pieces such as scrapers, burins, backed knives and the like. It seems to me that the correlation between function and form is very weak, in spite of previous expectations. If this contention is accepted, then retouched pieces during the Upper Palaeolithic owe their forms more to style than to function. Thus, contemporary foragers, whether they encountered a foreign group bearing their equipment or just found their discarded or deserted stone tools, could easily detect the presence of 'others'. Stylistic variability then becomes the means for marking group identities. As such their attributes deserve to be investigated, and employed in reconstructing 'life histories' of particular prehistoric populations. In this domain of research, hafting, or the production of composite tools, should be mentioned. An excellent example concerns the various types of projectiles produced during the Middle and Upper Palaeolithic that served as tips for spears and arrows (*e.g.,* Bergman and Newcomer 1983; Bergman *et al*. 1988; Knecht 1997 and papers therein; Shea *et al*. 2001). Various, but not all Upper and Epipalaeolithic microlith types fall in the same category and were hafted as arrowheads and barbs. The differences in shapes of the latter types and the details of their hafting techniques in the circum-Mediterranean area, had no bearing on the type and size of the hunted animals. Instead their variable forms reflect local styles. In a most generalizing observation, I would state that the shift in design, when suitability for function overrides style, is better expressed during the Neolithic period. Tool types such as sickle blades, perforators, adzes and axes and arrowheads, were shaped with a particular activity in mind.

Accidentally, some tools could have been used for other purposes, such as arrowheads employed in butchering (*e.g.*, Moss 1983).

Palaeo-Demography: Is that the Key?

Population growth in foraging as well as sedentary societies is thought to trigger cultural changes. Population increases have major implications, no less than population decreases that may have led to extinctions. Naturally, aspects of mobility, technology, and the distribution of resources are implicitly and explicitly embedded in explaining increases in producers and consumers. But how are these issues related to our topic?

The *chaîne opératoire*, as discussed above, is basically a system of technical skills learned by the user, and does not necessarily imply the use of language (although talking while knapping helps). On the basis of ethnographic observations, the *chaîne opératoire* employed in manufacturing a given product from a particular raw material represents the technical traditions of a specific group. The teaching of this skill through instructional sessions ensures the transmission of this knowledge from one generation to the next. Therefore, the time span during which a certain *chaîne opératoire* was practiced could indicate how long a particular technical tradition lasted. Typological analysis is likely to bolster this conclusion. Demonstrable stability of both aspects despite climatic fluctuations, when the spatial distributions of resources would be highly affected, indicates that changes in technical modes and tool types are not strictly related to environmental conditions.

This kind of information raises the issue of the biological and/or linguistic continuity of specific populations within a given region. Radiometric dates provide temporal depth, enabling us to identify the history of a social group or close kin interaction sphere. Effectively, this approach of combining *chaîne opératoire* and typological studies has already been employed by archaeologists studying Middle and Upper Palaeolithic assemblages.

Using the information obtained from studies of *chaîne opératoire* and tool typology as a common denominator, we gather the data required for inter-assemblage comparisons. Some researchers view the *chaîne opératoire* as a purely descriptive procedure and not as a valid palaeoanthropological measure facilitating the clustering of assemblages into industries. However, such an approach reduces the value of this analytical tool for identifying real past populations.

Indeed, during the Middle Palaeolithic the persistence of particular *Chaînes Opératoires* has a long duration. We may therefore assume that they represent a single biological population, and even the same linguistic tradition that facilitated the transmission of the cognitive model of the knapping method through teaching (Mithen 1995). It is also conceivable that population size expanded and shrank, by absorbing neighbouring groups, or losing members through extinction. Perhaps, given the possible fluidity of these Middle Palaeolithic societies, we should view them as early 'interaction spheres' rather than some sort of 'tribal' society or an agglomeration of bands.

The Upper Palaeolithic populations of Eurasia demonstrate increasingly successful adaptations to environmental changes, and in particular to demographic fluctuations (Kuhn and Stiner 2001). Courage and adventurous spirits led certain populations to cross the 'northern boundary' and adapt to arctic conditions, while others experimented with coastal ocean sailing which brought about the colonisation of Australia and adjacent islands (Blust 1995; Rolett *et al*. 1998; Stringer 1999). After the Last Glacial Maximum desertic regions, which had previously been abandoned during drier periods, were permanently occupied by foragers.

Indeed, Upper Palaeolithic entities exhibit the same demographic 'life histories' as those known from later historical periods. They comprise phases of emergence, efflorensence, long periods of success, ensuing stalemate, and final collapse (Goldstone in press). Discussion of particular examples is beyond the scope of this paper. Suffice it to say that similar processes can be detected in the dramatic changes that occurred during the Levantine Epipalaeolithic. We may regard the rise and fall of the Natufian culture as an example of how successful economic and social organisations resulted in the emergence of a complex society of hunter-gatherers, which ultimately, except for certain groups within its large population, collapsed in response to the vagaries of the Younger Dryas cold and dry period.

The 'life histories' of Upper Palaeolithic and Epipalaeolithic entities can be viewed not only through their *chaînes opératoires*, but also through site organisation, changes in food acquisition techniques (the Broad Spectrum Revolution – see Flannery 1969; Stiner 1999b), exploitation of variable environments, and social reorganisation. However, as this paper essentially concentrates on the lithic aspects of the Upper Palaeolithic, the treatment of these issues is offered.

A good example for changes in lithic industries is provided by studies conducted by Goring-Morris and associates (Goring-Morris *et al.* 1998). Core refitting of a series of Epipalaeolithic assemblages demonstrated how the same knapping techniques prevail while the style of the retouched pieces changed. There is no evidence that the latter developments reflect adaptations to shifts in the quality, distribution and accessibility of food resources. There is no evidence to date that food acquisition techniques, such as improvements in the construction of bows and traps, played a major role in typological changes in microliths. The most parsimonious explanation is that the different types of microliths designate different human groups, an explanation supported in part by the continuous geographic distribution of entities such as the Geometric Kebaran, Mushabian, Ramonian (or Late Mushabian), Natufian, Harifian, and the like. The manufacture of

particular types of microliths and points by each entity may indicate the preservation of particular mating systems, especially in the drier belt, as well as the use of the same language or dialect. The exploitation of the same core reduction strategies may testify to an enduring traditional unity, or the existence of some sort of interaction spheres. Given the limited geographic territory of these entities, we may speculate that their physical and linguistic boundaries were more clearly delineated than those of the Middle Palaeolithic (Close 2000). When compared to the earlier portion of the Upper Palaeolithic time span, the increasing spatial and chronological variability of the Epipalaeolithic reflects a major population increase following the LGM, and the opening-up of desertic environments for exploitation by highly mobile foragers. The situation in the southern Levant, known from extensive fieldwork in this area (*contra* the paucity and rarity of information from the northern Levant) may resemble the variability of recent demographic densities in New Guinea (Blanton 1995).

Interim Conclusions

Almost since the beginning of the 20th century, scholars have worried about the definition of archaeological entities as uncovered in excavations and surveys. Needless to mention the work of G. Kossima, G. Childe, D. Clarke and more recent critics who warn, justifiably, that prehistoric cultures cannot be directly equated with historical cultures (*e.g.*, Jones 1997). Nevertheless classification is a necessary device for arranging data. Using Celsius or Fahrenheit for measuring temperature does not have any bearing on the actual condition. The continued use of these two scales represents no more than cultural customs, habits, or even transmitted concepts. In considering tomorrow's temperature and, therefore, which clothes should be worn we decide according to our relative feeling of cold or warm. Acquisition of the *concept* represented by the measuring scale, which in this case is translated into a physical feeling, is primarily a matter of habituation from a young age. The same is valid for how one makes stone tools and the same would hold for how one defines prehistoric entities.

The various definitions assigned to assemblages do not lend themselves to a fully objective interpretation. Every prehistorian knows that when we mention the Mousterian the connotation involves a certain set of artefacts. Similar images emerge when definitions such as the Szeletian, the Bohunician, the Natufian and others are invoked, whether in oral or published reports. The social and historical meanings remain to be discussed by the interested parties. Hence basic classifications, although not always with agreed-upon scales as those employed for measuring temperatures, but incorporating categories with set combinations of attributes, are bare necessities. The systematic efforts of F. Bordes (1961a), D. de Sonneville-Bordes (1953), F. Hours (1974), and others, as well as more recently those of M. Bisson (2000) focused on this goal. Not always have these approaches included the concepts and the descriptive attributes of the techniques or methods through which the blanks were obtained. However, for now we are endowed with the works of Tixier (1963), Boëda (1995a), Meignen (1995), and Kuhn (1995) to mention just a few, and the importance of these studies of variable core reduction strategies cannot be over-emphasized, as shown by Dibble (1995b).

The same is true for the typological aspects of a given assemblage. Continuous modification processes of the so-called tools are well known (Keeley 1982; Dibble 1987), but the description of the lithic assemblages is done according to formal classifications, although one should be careful about their 'cultural' attributions. An excellent example is how Upper Palaeolithic Levantine assemblages have been incorporated or rejected from the taxon of the Levantine Aurignacian. In the final analysis, the Aurignacian needs to be defined on the basis of the original definitions. Variants do exist and should be taken into account, and yet, the endless expansion of the original definition, as was recently done (Kozlowski and Otte 2000) is unwarranted, for it only adds to the general ambiguity of defining the Aurignacian. In addition, lithic assemblages are all too often attributed to biological entities and not only by archaeologists. Biologists participate in the same game of equating haplo-type groups with prehistoric industries (Gibbons 2000; Semino *et al.* 2000).

In sum, returning to the questions asked in the opening remarks of this paper it does seem that at least in the Eurasiatic world, and probably in east and northeast Africa, the Upper Palaeolithic Revolution is well registered in the prehistoric record. Whether it all started due to an additional biological change among modern humans, or due to a technological transition that brought about the ensuing economic and in particular social changes, is still a debated issue. This revolution, like others, began in a 'core area' and dispersed, mainly through the movements of foragers who carried new equipment and especially new means for communication. Large-scale geographic distribution did not seem to interrupt the success of the mating systems in most regions. Faster changes (relatively to the Middle Palaeolithic) of operational sequences, and shifts in retouched tool morphology, together with the list of cultural attributes mentioned earlier, reflect flexible social systems, and rapidly increasing populations. The 'bottleneck' caused by the LGM, only slowed down the process of taking over new territories. It was immediately renewed as the glaciers began to melt. Therefore, the stone making traditions of the latest part of the Upper Palaeolithic, or Epipalaeolithic, present a variable set of retouched pieces, mostly microlithic, definitely more elaborate than during the earlier millennia. The accomplishments of the Upper Palaeolithic, and in particular the Levantine Epipalaeolithic created economically and socially the background on which the Neolithic Revolution could have taken place.

23. Final Remarks and Epilogue

Anna Belfer-Cohen and A. Nigel Goring-Morris

Introduction

Have any of the questions and problems raised in the introduction been addressed, let alone answered, in the preceding pages? We believe the present volume does contribute to understanding the Upper Palaeolithic phenomenon in the Levant, at least in terms of summarizing recent and current field projects. Both larger and more limited issues have received attention, thus serving as a point of reference for future studies. As is self-evident from the commentators' remarks, there is no consensus even at the level of the 'big' picture of Levantine Upper Palaeolithic developments. While Marks extols the virtues of the 1980's parallel phyla 'Ahmarian'/'Levantine Aurignacian' model, Copeland cautions against 'forcing' new data within too rigid a framework (see also remarks by Kuhn *et al*. herein). Yet, perhaps this very diversity of opinion should be viewed in a positive light, reflecting the dynamic nature of the subject matter, though limited in general to the lithics. For, ultimately, the Upper Palaeolithic signifies the beginnings of systematic modern behaviour, as regards all domains of human existence. In the following pages we will briefly address some of the varied issues relevant to current research, and point out what we believe to be potentially rewarding lines for further investigations.

Research Methodology

The Assumption of a Common Analytical Language?

When presenting prehistoric evidence and its interpretation, besides the unavoidable opaqueness resulting from the chronological remoteness of the data, there is always the issue of the researcher's scientific background. Prehistoric studies in the Near East and, especially, the Levant are blessed by the wealth of different research schools. These are probably more diverse than for any other region in the world. In addition to the largely British and French backgrounds of the pioneers of Levantine Upper Palaeolithic studies, there are German and American researchers, as well as native Levantines. Thus each of the researchers represents her/his own specific intellectual orientations and paradigms (see Clark 1991). The very wealth of variability can be two-edged, on occasion leading to dialogues in which people talk past one another. The assumption that we are indeed using a common analytical vocabulary and language needs to be critically examined. Yet this should be done without delving into the backgrounds of any researcher in particular, least we find ourselves in the absurd position of the judgemental and jingoistic 'we know better where it all comes from' (*e.g.*, see Clark's comment in Marks *et al*. 2001).

Nomenclature and its Implications for Cultural Definitions

It is unfortunately still a truism that the different preconceptions exhibited by various schools of research active in the region (American, French, Israeli, *etc*.) are further compounded by modern political boundaries and language barriers. Clearly one can no longer simply employ the term 'Aurignacian' as a synonym for the 'Upper Palaeolithic', just as no one today uses 'Neanderthal' to automatically denote a Middle Palaeolithic association. It is fascinating to observe the so-called 'Aurignacian' of Üçağızlı becoming 'Ahmarian-like' within the space of no more than 5–7 years (compare Minzoni-Deroche 1992, 1995 *vs*. Kuhn *et al.* 1999, herein). A similar preconception can be detected in the interpretation of the later Upper Palaeolithic levels of Umm el-Tlel, which Ploux (1999) and Boëda (personal communication) continue to attribute to the 'Aurignacian', notwithstanding the distinctly Masraqan/Late Ahmarian appearance of the illustrated assemblages (see also remarks by Copeland, and Nadel herein). Much the same has happened, for example, concerning the preliminary attribution of the late Ahmarian WHS618 assemblage (see Coinman this volume) to the 'Levantine Aurignacian' by Clark and his colleagues (Clark *et al*. 1987, 1988). Undoubtedly, not all of us are using the same criteria and definitions when referring to an

'Aurignacian' entity. As an additional example we can bring up the question of the Upper Palaeolithic assemblages from Warwasi in the Zagros, which were defined as 'Aurignacian' by some (Olszewski 1994), as opposed to others (Bar-Yosef and Belfer-Cohen in preparation). Furthermore, it is quite clear that the situation in terms of the Ahmarian/Aurignacian complexes differs considerably between the various sub-regions of the Levant (and see remarks in the introduction referring to the geographical isolation of Ksar Akil).

Indeed the criteria used recently to differentiate between the Aurignacian and Ahmarian phenomena are problematic. Notwithstanding techno-typological standards (see Bergman herein), the differentiation involves presence (in the Aurignacian) *vs*. absence (in the Ahmarian) of ornaments and bone tools. The former do occur sporadically in Early Ahmarian and related assemblages (Kuhn *et al*. herein; Bar-Yosef and Phillips 1977; Gilead 1981b). But though Marks (herein) points out problems concerning differential preservation of such organic and related items, the sheer variety and quantity of the bone and antler finds (and a range of symbolic items including shell ornaments, bone pendants, bird of prey talons, and ochre – see Belfer-Cohen and Bar-Yosef 1999; Rabinovich herein) in the Aurignacian *sensu stricto* reflect more than taphonomy and do, we believe, justify the validity of both the criteria and the division between these Upper Palaeolithic techno-complexes.

People tend to use these terms in a variety of ways. Some employ them quite flippantly, considering them as general-purpose repositories (indeed is every 'blade-oriented' assemblage in the Levant necessarily 'Ahmarian'? see Bergman herein *vs*. Gilead 1989), while others are far more particularistic. It is not always clear within the literature on what plane these terms are used (see, for example, the evolutionary stages in the use of the respective terms by Coinman, Kerry and Henry herein and references therein). Though the recognition of the Ahmarian techno-complex within the Upper Palaeolithic sequence of the Near East was of crucial importance, we believe (for details see Belfer-Cohen and Goring-Morris 2002; Belfer-Cohen and Bar-Yosef 1999; and also see Kuhn *et al*. herein) that it is now the time to define new taxa, instead of trying to fit every Upper Palaeolithic archaeological occurrence either within the 'Aurignacian' or 'Ahmarian' *sensu stricto*. Examples for such an awkward fit can be drawn from the later part of the Upper Palaeolithic sequence. To illustrate, we do not negate the possibility that the Late Ahmarian/Masraqan ultimately derives from the Early Ahmarian, yet the chronological, technological and typological proclivities are sufficiently distinctive, we believe, to warrant a separate appellation (see also Ferring 1988). It seems to us that there is a wide range of unaccounted for variability that is lost if we employ just the broad-based 'Aurignacian' *vs*. 'Ahmarian' terminology. One should bear in mind that, in the final analysis, we are attempting to investigate actual prehistoric populations that exploited real territories by specific strategies. As research progresses and the data base increases, we are thus able to propose more detailed models. This is not to say that everything can be neatly apportioned into specific boxes. Various assemblages still remain enigmatic, and, for example, we continue to ponder the nature of some of the Ksar Akil levels (Bergman herein), Kebara IV–III (Bar-Yosef *et al*. 1996) and the Qafzeh sequence (Ronen and Vandermeersch 1972).

Undoubtedly the material culture remains reflect the nature, intensity and dynamics of activities on-site. But to what extent do the recovered assemblages represent the full suite of activities? This is most especially relevant with regards short-term occupations. The compositions of the recovered toolkits by no means represent always the full range of activities, as refitting studies indicate considerable mobility of tools into and out of sites. The cautionary tale of Early Ahmarian Nahal Nizzana XIII is revealing: almost no blade tools remained on-site, and although they were the primary focus of knapping activities, the occupants removed these tool types on abandonment of the site (Davidzon 2002; see also the papers by Becker and Monigal herein concerning Boker A and the Abu Noshra sites).

This raises the thorny problem concerning the criteria and preconceptions by which we attribute assemblages within concrete archaeological entities. A notable case study relates to the assemblage of Sde Divshon (D27B), which was assigned to the Early Ahmarian by Ferring (1976) and Marks (1977b), but to the Levantine Aurignacian by Gilead (1981a, 1989), as each of the researchers used different analytical criteria, although all three agree to the bi-partite division and contemporaneity of these Levantine Upper Palaeolithic strands. Following Gilead's (1981a, b) definitions, the Nahal Nizzana XIII assemblage, where flakes outnumber blade/lets among both debitage and tools, should be attributed to the Aurignacian. Yet, the refitting programme at Nahal Nizzana XIII clearly demonstrates that typical Early Ahmarian blade/lets were the primary focus of blank and tool production.

Technology

Nomenclature is clearly significant also with regards to the definition and understanding of technological processes, which are of paramount importance when dealing with the definitions of archaeological cultural entities. Technology has gained much prestige and importance through the advent and adoption of the *chaîne opératoire* method, which is currently the main topic in technological studies. Yet even here, we can see differences in interpreting the *chaîne opératoire* phenomena if we compare the respective attitudes expressed by Bergman, Chazan and Sarel and Ronen (herein).

It is quite clear that the different backgrounds and perceptions of the various researchers will influence each

and every aspect of technological studies. This can even be observed at the most basic level of primary definitions: for example, what is a cortical (primary) element? While some consider that these items should retain 50% of cortical surface coverage, others settle on 25–30%, yet others ignore them altogether (*e.g.*, Fox herein). Another example concerns the notion of laminarity (Tostevin *contra* Bergman herein). There are also significant differences in describing the presence and nature of platform faceting – the textual description and illustration by Fox of the '*chapeau de gendarme*' contrasts with widely accepted definitions (*e.g.*, see Tixier *et al*. 1980). When comparing the data presented by Tostevin (herein, Table 6.2) with the original publication of the same data by Marks and Kaufman (1983, p. 74, table 5.3), a major difference in the degree of faceting at Boker Tachtit is observed.

A slightly different example concerns the term 'platform blade', which is quite commonly employed by some researchers (see papers by Coinman, Fox, and Olszewski). The illustration in Figure 13.5 apparently represents what others over the years have called a 'ridge blade' (as opposed to the more distinctive '*lame à crête*' or crested blade that is a specific sub-category of ridge blade – see Clark and Rankine 1939). These core trimming elements often display unifacial lateral scar patterns on their distal portions. They are quite common throughout most Upper Palaeolithic and Epipalaeolithic industries in the Levant. Refitting studies demonstrate that they do not always derive from the striking platform edge. This would be counter-productive as a rejuvenation technique, increasing rather than decreasing the angle between the platform and the removal surface. Rather, they generally derive from the main removal surface often immediately after a core tablet was struck off, shortening the length of the removal surface. These 'platform blade/lets' are slightly overshot, including part of the keel at the base of the core. They also derive from lateral carination, which may be seen as a means of blunting to ease holding the core during knapping (ANG-M personal observation; and Marder in preparation).

Differences in analytic procedures pertaining to technology are observed even among various participants of the same overall project (*i.e.*, Wadi Hasa, and see Coinman, Olszewski, Fox herein; Neeley *et al*. 2000). And we are still not referring to the more significant aspects of technological studies. A case in point is the study of cores and their flaking scars. To what extent are cores in their final, abandoned and exhausted states really representative of the flaking mode actually used in reducing them (*à propos* Sarel and Ronen herein)? We doubt that there is often a direct correlation between the two – ultimately it is the *original setting-up of the core* into a preform that reflects the *basic intentions of the knapper*. Thus the shape of the abandoned core portrays rather the degree to which the knapper succeeded in managing the block of raw material at hand during the course of its reduction, which can be highly significant from a technological perspective. This is neatly illustrated again by refitting studies at Early Ahmarian Nahal Nizzana XIII, where a conceptually preconceived and redundant approach met the realities of variable raw materials, combined with probable differences in individual knapping skills (Davidzon 2002).

Typology

Over the past two decades research has focused primarily upon technological criteria in the investigation of the Levantine Upper Palaeolithic. Indeed, for the Ahmarian, the basic *chaîne opératoire* has lately been thoroughly documented (though for the Aurignacian and other flake industries the current state of technological knowledge still leaves much to be desired). Typological issues have mostly taken a secondary place with regards lithic analysis and, where relevant, are largely relegated to statistical issues. Indeed, amongst many researchers, antagonism against the very notion of 'type fossils', let alone their use, is almost palpable. Yet, whether one approves of the notion or not, it cannot be denied that a variety of distinctive tool types, restricted to certain chronological horizons and geographically limited, do occur through the Upper Palaeolithic sequence in the Near East. Examples include the Emireh point, the *chanfrein*, the Ksar Akil scraper, burins on Clactonian truncations/ notches, *etc*. Ultimately, these do serve as cultural markers, just as we employ the presence/absence of bone and antler artefacts, provided we remain alert and use it wisely and in moderation (see summary in Flannery 1986).

Questions concerning typological definitions of modified items also reflect much wider issues. A troublesome example relates to the obvious differences in the definitions of point types (see Copeland herein for Upper Palaeolithic point types in the Levant). With reference just to el-Wad points, as employed by various researchers, it is of interest to see the differences in the approaches of Bergman, Phillips and Saca, and Becker herein, as well as those of Azoury (1986) and Ploux (1999). The situation is further complicated by the fact that Garrod originally considered the el-Wad (*sic* Font Yves) point as a type-fossil of the 'Levantine' Aurignacian. Today the el-Wad point is considered by many to be a primary hallmark of the Early Ahmarian (see Belfer-Cohen and Goring-Morris 2002 and references therein). Until such a time as we are able to either substantiate or negate claims that there is indeed variability between el-Wad points in Early Ahmarian as opposed to those in Aurignacian assemblages, we cannot use the el-Wad point as a cultural marker. The case of the el-Wad point is currently a weak link in the arguments for the validity of such criteria for the definition of the various cultural entities.

Assemblage integrity

Assemblage integrity is obviously a major issue to be addressed in evaluating archaeological developments. The problem is especially acute with regards multi-level

occupations, especially in caves and rockshelters. The matter is further complicated when re-analyzing assemblages from early excavations, when field methodologies were relatively unsophisticated. One can compare the detailed stratigraphy of the later Upper Palaeolithic levels identified and described by Tixier and Inizan (1981) at Ksar Akil, with that provided by the earlier excavations at the site that were based on much larger stratigraphic units (see details in Bergman 1987).

Additionally there are the long-recognized possibilities of admixtures resulting from post-depositional taphonomic processes (Bar-Yosef and Vandermeersch 1972). For the Middle to Upper Palaeolithic transition these issues are especially crucial. Yet, while admitting the problem of potential mechanical admixtures in the Carmel and Galilee sites, Sarel and Ronen (herein) do not really address the problem in any detail. Much the same can be said of the described sequence at Tor Sadaf (Fox herein); do all three of the arbitrarily defined assemblages really reflect a single continuum? There is thus clearly a necessity for in-depth studies of site formation processes to evaluate the integrity of assemblages (see Goldberg herein).

Another factor to be considered relates to sample sizes and the areas exposed. The described assemblage from Tor Fawaz (Kerry and Henry herein) is quite limited, notwithstanding its derivation from $12m^3$, raising the question as to whether the described assemblage does indeed represent a single occupation horizon. Also relevant in this context is the matter of inter-assemblage comparisons. Both Nadel, and Kaufman (herein) compare late Upper Palaeolithic/early Epipalaeolithic assemblages deriving from quite different types and scales of excavation. The assemblages from Ohalo II, Ein Aqev, Ein Aqev East and Shunera XVI all derive from extensive surfaces, while for example the Fazael IX, X and Nahal Ein Gev I samples derive from small test pits. Inevitably this raises questions as to the validity of inter-assemblage comparisons.

Dating and Geomorphological Processes

Notwithstanding the rise in the number of radiometric dates currently available for the Upper Palaeolithic period in the Levant (see Appendix), it seems that instead of providing a solid chronological framework, they frequently obfuscate matters. In part, no doubt, this has to do with the fact that the earlier stages of the Upper Palaeolithic approach the limits of the 14C dating method, playing havoc with the size of standard deviations, *etc.* (even for later periods the issue is contentious in terms of the reliability of dates). Another matter to be integrated concerns the possibilities and necessities of calibration (see Schramm *et al.* 2000). Thus the site of Ohalo II, with a large series of radiometric dates at *ca.* 19,000 bp corresponds to *ca.* 22 ky when calibrated. The differences between radiocarbon years and their calibrated values can reach up to 5,000 years.

We frequently tend to 'blame' the absence of dates for our inability to comprehend the nature of the prehistoric record. Yet the above-mentioned case of Ohalo II is a cautionary tale. The splendid series of dates now available clearly indicates that the site was occupied for some 2000 radiocarbon years (Nadel *et al.* 1999). Still the stratigraphic observations at Ohalo II do not always accord with the dates obtained. One wonders whether the site as a whole was indeed continuously occupied over such a lengthy duration? Based on the intensity and nature of the finds we believe that the Ohalo II site most probably represents a sequence of short-duration palimpsests over a considerable period of time. A somewhat similar phenomenon can be cited with regards the wide range of dates (*ca.* 39–31,000 bp, excluding outliers) from the Abu Noshra sites. Yet lithic refits between some Abu Noshra assemblages indicate that they are absolutely contemporary (see Phillips 1991; Becker 1999, herein).

We are nevertheless fortunate in having the results of the innovative environmental research at Soreq cave, as well as detailed studies of the Lisan lake levels (Bar-Matthews and Ayalon herein; Bartov *et al.* 2002). Accelerator dates have been particularly beneficial for dating archaeological materials, yet until the recent extension of the calibration curve backwards to include the Upper Palaeolithic we were in somewhat of a quandary (Beck *et al.* 2001; Schramm *et al.* 2000). The combination of the calibration to calendric years, together with the high-resolution proxy climate studies, should enable more rigorous examination and integration of the archaeological and environmental data. This may facilitate direct correlation with specific geomorphological processes, such as erosional events, increased spring flow, ponding, localised lakes, dune incursions, terraces, palaeosols, *etc.*

Settlement Patterns and Site Variability

Perhaps because of the opaqueness of the Upper Palaeolithic archaeological record there is a tendency (even unconsciously) to interpret the observed archaeological phenomena within a strictly ecological dictum. Granted, there is an almost innate connection between water resources and the location of sites especially in the marginal zones; still, it is quite obvious that once we get a little more detailed information, both environmental and archaeological, the picture generated is much more complicated. We should be wary of comprehending the dichotomy between the Levantine Aurignacian and the Early Ahmarian only from an ecological perspective (Kerry and Henry, and Williams herein). This approach may relate to the backgrounds of the researchers, their theoretical paradigms and the notion that archaeological variability, more than anything, reflects environmental adaptation. Whether right or wrong, most probably the truth (if at all), is somewhere in between, *i.e.*, the environment and climatic conditions are *part* of the considerations which led Upper Palaeolithic peoples to

create their own particular network of sites, routes of communication, *etc*. Given the complexity of human behaviour, sheer proximity to permanent water sources did not make individuals more 'Ahmarian' or less 'Aurignacian' and *vice versa*.

As noted long ago most Upper Palaeolithic sites tend to be quite ephemeral, presumably reflecting highly mobile, small bands exploiting extensive territories, not only in the more arid regions but also within the Mediterranean zone. One speculates about the scale of movements by specific bands within the south-central Levant. It seems unlikely that specific groups would have had seasonal rounds encompassing both the central Negev and the Lebanese coast (a span of some 400 km). Yet the particularistic techno-typological similarities of some of the central Negev (*i.e*., Boker BE) and Wadi Hasa (Thalab al-Buhayra) assemblages, less than 150 km apart, each featuring distinctive Ksar Akil scrapers and truncated blades, would appear to confirm the settlement model predicted by Larson (1979), prior to any research in southern Jordan. Interestingly this is notwithstanding various subsequent studies contrasting the so-called central Negev model with that for south-central Jordan (see references in Coinman, and Kerry and Henry herein).

Origins and Transitions

Was the Middle to Upper Palaeolithic transition a gradual transformation developing locally, *in situ*, or was it a swift revolution, a fresh start with new ideas and/or people coming from elsewhere? Given the limits of space we will only briefly comment on the issues of Levantine Upper Palaeolithic origins and the Middle to Upper Palaeolithic and the Upper to Epipalaeolithic transitions as touched upon in the present volume.

Sarel and Ronen see a local continuity, while Tostevin strongly argues for a revolution, initially taking place in an as yet unknown locality, negating all possible ties between the local Middle and Upper Palaeolithic. Both approaches leave much to be desired. Sarel and Ronen avoid the thorny issue of the postulated mechanical admixture of the 'transitional' assemblage (and see above). Tostevin's argument encapsulates what we consider to be an inherent flaw in terms of general techno-typological trends being translated into absolute values, which are then translated into 'indices' of change (see also remarks by Marks herein). There are also some major differences in the ecological settings of the assemblages he used for comparison – *e.g.*, Kebara VI *vs.* Boker Tachtit. Tostevin does acknowledge that in terms of the assemblages he analysed, his were more or less 'no other choice' choices, still there is no justification for accepting the comparisons at face value.

If, for the sake or argument, we accept that there was no endemic, local Middle to Upper Palaeolithic transition in the Levant, the question then arises as to potential antecedents and directions of diffusion. Tostevin discusses the possibility for the origins of the initial Upper Palaeolithic package deriving from either the Nile Valley, or from somewhere between the Levant and central-eastern Europe (Anatolia?). Yet, as he himself admits, the evidence is sparse or non-existent. Those assemblages from central-eastern Europe that are similar to the initial Upper Palaeolithic ones in the Levant are unequivocally later in time. With respect to north Africa, the occurrence of chamfered pieces in the Dabban of Cyrenaica (which are at least superficially similar to those in Ksar Akil, Lebanon) is intriguing (see remarks by Marks herein), yet there is a notable absence of other relevant terminal Middle to initial Upper Palaeolithic occurrences. In light of the intensive research in the Nile Valley over the past four decades this absence seems to be significant and likely reflects the actual situation. Indeed the absence of contacts between the Nile Valley and the Levant throughout almost the entire span of the Upper Palaeolithic is conspicuous.

Nevertheless, recent genetic studies do lend credence to at least elements of the Out-of-Africa model (*e.g.*, Semino *et al*. 2000). Thus it is quite possible that certain elements of the Upper Palaeolithic package do indeed derive from outside the Levant, perhaps combining with local developments as a catalyst for change. These may have resulted in more profound changes than the sum of the separate parts. In such a scenario some elements of the initial Upper Palaeolithic package may perhaps be profitably sought through another and equally, if not more, plausible alternative route for an Out-of-Africa model. This is by way of the Horn of Africa to Yemen/Saudi Arabia and thence up the Red Sea coast, an area that remains archaeologically *terra incognita*.

Still, the option of an *in situ* transition from Middle to Upper Palaeolithic in the Levant cannot be ruled out entirely. Lately, McBrearty and Brooks (2000), in a detailed compilation of early modern human behavioural correlates throughout Africa, argue for African origins of the Upper Palaeolithic phenomenon. They propose that these indicate continuity across the local Middle-Upper Palaeolithic boundary. Almost all of the evidence they cite appears equally early in the Near Eastern Middle Palaeolithic (ochre, symbolic/artistic endeavours, *etc*.). Other aspects of extra-somatic modern human behaviour (*e.g*., 'out of the brain' storage of symbolism, systematic spatial organization of activities) in Africa recently discussed by Wadley (2001) occur also in the Near Eastern Middle Palaeolithic.

The picture is, of course, even more complicated, as the transitional, Middle to Upper Palaeolithic assemblages display considerable variability among themselves – compare Umm el-Tlel, Ksar Akil, Emireh, Boqer Tachtit, Tor Sadaf, WHS 623X, *etc*. In this context of the transitional/initial Upper Palaeolithic the small Tor Fawaz assemblage (Kerry and Henry herein) is likely also relevant, as well as other as yet unpublished sites, *e.g*., Nahal Eilonim in the central Negev (personal observation).

What do the changes reflected by the transitional assemblages signify in behavioural terms? Indeed, to what extent are the changes even visible in the material record? What is the role of the posited changes in hafting and/or means of propulsion for projectile points? Certainly lighter and more symmetrical projectiles replace heavier, and sturdier ones. But is there also a shift to more discrete functional classes from Middle to Upper Palaeolithic lithic toolkits, together with a concomitant tendency to increased standardization in the morphological aspects of the toolkits (see Mellars 1989; Mellars *et al*. 1999 *vs*. Marks *et al*. 2001)?

Are the changes in knapping from the Middle Palaeolithic to Ahmarian really as dramatic as Chazan (herein) contends? In our view the conceptual changes of volumetric *vs*. surficial (see Géneste 1985; Boëda 1994, 1995a, b) are, perhaps, sometimes over-emphasized, reflecting the intrusive nature of the Upper Palaeolithic phenomenon in Europe that tends to contrast the differences in a starker light.

There appears to be a consensus that transition to modern human behaviour involved broader conceptual changes in the organization of activities, functional, symbolic and spatial. Evidence for definitely modern behavioural correlates already occur sporadically during the Middle and, even, Lower Palaeolithic – and various examples can be cited in the Near East, *e.g.*, Berekhat Ram, Quneitra, and Qafzeh (Goren-Inbar 1986, 1990; Hovers *et al.* 1997; Marshack 1997). Ultimately, the issue revolves around the matter of systematic, patterned behaviours. The neural 'wiring' may have been in place for a considerable period of time, but the overall integration of the system *as a whole* took a while to become normative.

And what about the Upper Palaeolithic sequence itself? The relationship between the 'Ahmarian' and the 'Aurignacian' is still to be satisfactorily defined, let alone explained (see above and Williams herein). We do know by now that the Levantine Aurignacian *sensu stricto* derives from outside the region, though where from remains speculative. As data accumulate the picture becomes more complicated. Thus is it possible to hypothesise that there was more than one event that brought about the Upper Palaeolithic as we know it? Certainly the evidence Bergman presents in his paper on Ksar Akil, with two separate stratigraphic blocks of 'Aurignacian' type industries, appears to indicate two separate intrusive 'pulses'.

Here we re-encounter the question of 'Aurignacian' definitions, not just in the immediate Levantine sphere but also further afield. While cursorily dealt with in a previous section of this chapter, it is important to raise yet again the issue of common denominations when dealing with local archaeological entities. While there may be increasing consensus with regards the issue of 'modernity', it should nevertheless be emphasized that whereas the Initial Upper Palaeolithic in the Levant concerns the 'Ahmarian' *sensu lato*, for most Europeans the equivalent relates to the 'Aurignacian' entity. Conversely, in the Levant the Aurignacian is a relative latecomer with a restricted geographical distribution.

We should bear in mind that connections between areas are and were dynamic, so that what moves in one direction at one point in time can subsequently return from the opposite direction in a totally different guise. The European Aurignacian may be explained as the sum of the ingredients accumulated on the long trek by the pioneering Upper Palaeolithic bands from Africa to Europe – thus the Aurignacian recognized in western Europe is actually autochthonic, as only there it exhibits all the classic Aurignacian attributes (Bar-Yosef 2000; Tostevin herein).

Progressing through time we encounter yet again the question of the nature and significance of transitions, this time the one to the Epipalaeolithic. Gilead (1984) has argued for continuity through to the Natufian entity, which proclaimed incipient sedentism and increasing social complexity. Indeed, few if any, would argue against the Early and Middle Epipalaeolithic representing anything but the continuity of a mobile hunter-gatherer foraging mode. Nevertheless the pace of change alters quite dramatically after *ca.* 22,000 bp (see Goring-Morris and Belfer-Cohen 1997). Overall, the behavioural changes from the Upper Palaeolithic through the Epipalaeolithic are generally accretional, as many characteristic elements occur sporadically earlier. As regards hunting practices there is a clear widening of the equipment repertoire, with the beginnings of systematic (?) trapping/snaring and sometimes fishing during the course of the Upper Palaeolithic (see Rabinovich herein). Bone and antler (and, perhaps speculatively, wood) were used more commonly as raw materials for hunting and processing implements. There are even hints for the beginnings of weaving of nets and baskets (Nadel *et al*. 1994), for storage and other purposes, while ostrich eggshell containers may also be documented (Gilead 1977; Goring-Morris 1987).

Yet, perhaps the most significant difference between the Upper Palaeolithic and the Epipalaeolithic relates to the clearly demarcated evidence for territoriality, reflected by the rapid changes in the emblemic style of microlith proclivities from *ca*. 22,000 bp (Fellner 1995; Belfer-Cohen and Goring-Morris 2002; and see Wadley 2000 for defining stylistic changes pertaining to social and environmental challenges). This seems to represent a conscious and intentional tightening of social networks, perhaps in response to the onset of the extreme conditions during the Pleniglacial in the Levant. As conditions deteriorated competition would have increased, leading to more restricted (refugia) territories (the coastal plain, the Rift Valley, and inland lacustrine basins) and a concomitant widening of the resource base (see Goring-Morris and Belfer-Cohen 1997). It is in this light that the nature of Ohalo II (and the Ein Gev sites) should be understood (Bar-Yosef 1970; and the papers of Nadel, Kaufman, and Olszewski herein).

Epilogue

It is the beginning and end of the Upper Palaeolithic that illustrate most clearly the significance of this period. Gone is the ambiguity of parallel human lineages sharing cultural affinities (Neanderthals and Anatomically Modern *Homo Sapiens*), and we are now facing *Homo Sapiens sapiens* as the sole representative of humanity all over the world.

The end of the Upper Palaeolithic brings us into the domain of rapid changes, the dominant tempo of eras to follow, and one can nearly touch the great transformations to come: sedentism, agriculture, pastoralism, incipient formalisation of belief systems, *etc*.

The fact that we are dealing with a single species (*i.e.*, us), as well as the comparative chronological proximity to the present, justifies the use of ethnographic data and the wider human experience for comparative and inferential purposes – so that speculations are now based on sharing the basic characteristics (of individuals and groups) as fellow humans.

The above makes life more straightforward for researchers of the Upper Palaeolithic in comparison to earlier periods. Even so, only smatterings of Upper Palaeolithic behaviours can be deduced from the archaeological material at hand. One can despair and let go. Yet, there is also the possibility to try and tackle the archaeological vestiges, however fragmentary and sporadic they may be.

Whatever the origins of the Upper Palaeolithic and all that it encapsulates, there can be no denying that the Near East and the Levant in particular play a pivotal role concerning the origins and dissemination of modern human behaviours throughout the Old World. The contents of the present volume present summaries of the nuts and bolts perspective of the Upper Palaeolithic phenomenon. Yet it seems that whatever insights we have gained in the last few years of research, they have come about precisely through the investigation and integration of such mundane aspects. It is our firm belief that, though tedious and sometimes despairing, this is the only avenue open for archaeologists to appreciate the wider implications of modern human behaviour in all its diversity during the Upper Palaeolithic.

Appendix

Radiometric Dates for the Upper Palaeolithic of the Levant

Note: *italics* relate to dated geological sediments associated with but not necessarily dating the archaeological occupation.

Site	Level/Square	Height/Spit	Date bp	±	sd	Lab.	Material	$\delta^{13}C$ ‰	Tentative Cultural Assignment
Üçağızlı	above Layer B	breccia	31,060		140	AA-35258	charcoal		Early Ahmarian?
Üçağızlı	Layer B		29,130		380	AA-38203	aragonite		Early Ahmarian?
Üçağızlı	Layer B1		322,670		760	AA-38201	aragonite		Early Ahmarian?
Üçağızlı	Layer F		34,000		690	AA-35260	charcoal		Transitional /Initial UP
Üçağızlı	Layer F		35,020		740	AA-37624	charcoal		Transitional /Initial UP
Üçağızlı	Layer G		39,100		1,500	AA-37626	charcoal		Transitional /Initial UP
Üçağızlı	Layer H		33,040		1,400	AA-37623	charcoal		Transitional /Initial UP
Üçağızlı	Layer H		35,670		730	AA-35261	charcoal		Transitional /Initial UP
Üçağızlı	Layer H		38,900		1,100	AA-27995	charcoal		Transitional /Initial UP
Üçağızlı	Layer H		39,400		1,200	AA-27994	charcoal		Transitional /Initial UP
Üçağızlı	Layer H		41,400		1,100	AA-37625	charcoal		Transitional /Initial UP
Umm el-Tlel 2	V		30,310		670	Gif-900/34	charcoal		Indeterminate UP
Umm el-Tlel 2	XI		30,790		760	Gif-900/40	charcoal		Transitional
Ksar Akil	Couche 3 upper (=Phase I)		23,170		400	OxA-1791	charcoal		Nizzanan?
Ksar Akil	Couche 3 major (=Phase I)		22,850		400	OxA-1792	charcoal		Nizzanan?
Ksar Akil	Couche 3b lower (=Phase I)		22,050		360	OxA-1793	charcoal		Nizzanan?
Ksar Akil	Couche 3bb (=Phase I)		22,480		380	OxA-1794	charcoal		Nizzanan?
Ksar Akil	Couche 3c (=Phase I)		22,850		380	OxA-1795	charcoal		Nizzanan?
Ksar Akil	Level 4 (=IV-VII)		14,100		500	MC-411	bone		Early Kebaran?
Ksar Akil	Level 4 (=Phase II)	top stony complex	24,450		?	MC-410	charcoal?		Early Kebaran?
Ksar Akil	Couche 7bb (=Phase III)		21,100		500	OxA-1796	charcoal		Early Kebaran?
Ksar Akil	Couche 8a (=Phase III)		26,900		600	OxA-1797	charcoal		Early Kebaran?
Ksar Akil	Couche 8a (=Phase III)		26,500		900	MC-1191	charcoal		Early Kebaran?
Ksar Akil	Couche 8ac (=Phase III)		29,300		800	OxA-1798	charcoal		Early Kebaran?
Ksar Akil	Couche 9a (=IV)		30,250		850	OxA-1803	charcoal		Levantine Aurignacian
Ksar Akil	Couche 9 (=VII)		27,350		?	MC-679	charcoal		Levantine Aurignacian
Ksar Akil	VII-IX		28,240		380	GrN-2195	shell		Levantine Aurignacian
Ksar Akil	Couche 10 lower (=VI)		31,200		1,300	OxA-1804	charcoal?		Levantine Aurignacian
Ksar Akil	Couche 10 (=VIII)		27,000			MC-686-688	av. of 3 dates		Levantine Aurignacian
Ksar Akil	Couche 10 (=VIII)		26,000			MC-680-684	av. 4 of dates		Levantine Aurignacian

Site	Level/Square	Height/Spit	Date bp	±	sd	Lab.	Material	$\delta^{13}C$ ‰	Tentative Cultural Assignment
Ksar Akil	Couche 10 (=VIII?)		28,600		680	MC-?			Levantine Aurignacian
Ksar Akil	Couche 11bm (=VI)		32,400		1,100	OxA-1805	charcoal		Levantine Aurignacian
Ksar Akil	Couche 12 (=VII X?)		32,000		1,500	MC-1192	charcoal		Levantine Aurignacian
Hayonim Cave	D1-2		16,240		640	Hv-2675	bone		Levantine Aurignacian?
Hayonim Cave	D2		15,700		230	OxA-2803	bone		Levantine Aurignacian?
Hayonim Cave	D1-2		16,240		640	Hv-2675	bone		Levantine Aurignacian?
Hayonim Cave	D2/J19cd	190–199	15,700		230	OxA-2803	bone		Levantine Aurignacian?
Hayonim Cave	D/H20b	225–230	21,650		340	OxA-2804	bone		Levantine Aurignacian?
Hayonim Cave	D3/I-J20	200–205	20,810		320	OxA-2806	bone		Levantine Aurignacian?
Hayonim Cave	D3/G22a	220–240	28,900		650	OxA-2801	bone		Levantine Aurignacian
Hayonim Cave	D/J21a	220–230	27,200		600	OxA-2802	bone		Levantine Aurignacian
Hayonim Cave	D/J20	180–220	29,980		720	OxA-2805	bone		Levantine Aurignacian
Qafzeh	Level 9		31,950			asparatic acid	bone		Early Ahmarian
Qafzeh	Level 9		38,950			asparatic acid	bone		Early Ahmarian
Qafzeh	Level 9		46,950			asparatic acid	bone		Early Ahmarian
Ein Gev I	Level 4		15,700		415	GrN-5576	bone		Late Kebaran
Haon II	Level 3		18,350		600	RT-386	shell?		Late Kebaran
Ohalo II Loc 1 wall	D81c	-212.33	21,050		330	RT-1625	charcoal	-21.8	Masraqan/Late Ahmarian
Ohalo II Loc 1	E80b	-212.40–45	19,590		150	RT-1616	*Pistacia a.*	-13.4	Masraqan/Late Ahmarian
Ohalo II Loc 1	E80b	-212.50–55	18,700		180	RT-1617	*Populus e.*	-23.2	Masraqan/Late Ahmarian
Ohalo II Loc 1	G80c	-212.41–43	18,210		240	RT-1623	*Tamarix*	-21.0	Masraqan/Late Ahmarian
Ohalo II Loc 2	E85d	-212.25–32	19,860		190	RT-1619	*Tamarix*	-20.2	Masraqan/Late Ahmarian
Ohalo II Loc 2	E86b	-212.38–43	17,500		200	RT-1297	charcoal	-22.7	Masraqan/Late Ahmarian
Ohalo II Loc 2	F86b	-212.32–36	19,220		180	RT-1618	*Tamarix*	-20.6	Masraqan/Late Ahmarian
Ohalo II Loc 3	B85b	-212.12–14	19,000		190	RT-1251	charcoal	-22.0	Masraqan/Late Ahmarian
Ohalo II Loc 3	B85c	-212.15–16	19,800		360	RT-1248	charcoal		Masraqan/Late Ahmarian
Ohalo II Loc 3	B88d	-212.08–28	19,500		170	RT-1342	charcoal		Masraqan/Late Ahmarian
Ohalo II Loc 3	B89b	-212.13–15	18,900		400	RT-1252	*Tamarix*		Masraqan/Late Ahmarian
Ohalo II Loc 3	B89b	-212.15–20	19,250		460	RT-1250	*Tamarix*	-24.4	Masraqan/Late Ahmarian
Ohalo II Loc 3	C85a	-212.15–19	20,100		440	Pta-5387	charcoal	-17.9	Masraqan/Late Ahmarian
Ohalo II Loc 3	C85c	-212.08–13	18,600		220	RT-1343	charcoal	-19.5	Masraqan/Late Ahmarian
Ohalo II Loc 3	C87d	-212.20–25	19,310		190	OxA-2565	*Hordeum*	-24.4	Masraqan/Late Ahmarian
Ohalo II Loc 3	C87d	-212.25–30	19,110		390	OxA-2566	*Hordeum*	-24.6	Masraqan/Late Ahmarian
Ohalo II Loc 3	C88b	-212.16–18	19,400		220	Pta-5374	charcoal	-19.2	Masraqan/Late Ahmarian
Ohalo II Loc 3	C89a	-212.15–20	18,360		230	RT-1244	charcoal	-21.5	Masraqan/Late Ahmarian
Ohalo II Loc 3	D89a	-212.06–14	19,600		400	Pta-5386	charcoal	-23.6	Masraqan/Late Ahmarian
Ohalo II Loc 4	AB87	surface	15,550		130	RT-1246	charcoal	-20.9	Masraqan/Late Ahmarian
Ohalo II Loc 4	AB87a	-212.12	18,680		180	OxA-2564	*Hordeum*	-24.5	Masraqan/Late Ahmarian

Site	Level/Square	Height/Spit	Date bp	±	sd	Lab.	Material	δ^{13}C ‰	Tentative Cultural Assignment
Ohalo II Loc 4	AB87c	-212.00–03	18,760		180	RT-1358	charcoal	-20.8	Masraqan/Late Ahmarian
Ohalo II Loc 6	AA79a	surface	20,830		180	RT-1620	*Fraxinus s.*	-19.7	Masraqan/Late Ahmarian
Ohalo II Loc 7	H89a	-212.33–35	20,070		270	RT-1621	*Rhamnus*	-21.5	Masraqan/Late Ahmarian
Ohalo II Loc 8	H87d	-212.40–45	20,190		170	RT-1622	*Pistacia a.*	-18.4	Masraqan/Late Ahmarian
Ohalo II Loc 10	L79cd	-212.50–60	20,840		290	RT-1624	charcoal	-20.6	Masraqan/Late Ahmarian
Nahal Oren IX			18,250		320	UCLA-1777c	bone		Kebaran
Nahal Oren IX	308.0/28		3,100		130	OxA-395	wheat seed		Kebaran
Nahal Oren IX	308.0/28		6,650		190	OxA-396	humic acid from 395		Kebaran
Nahal Oren IX	307.0/32.33		>33,000			OxA-390	wheat seeds		Kebaran
Nahal Oren IX	307.0/33		2,940		120	OxA-389	wheat seeds		Kebaran
Sefunim	Level 9		12,250		65	Hv-4074	?		Levantine Aurignacian?
Sefunim	?		10,960		390	Pta-2827	collagen		Levantine Aurignacian?
Raqefet			18,910		300	I-6865	bone		Kebaran?
Kebara	B?/C? D19R		12,470		180	OxA-2798	human	-22.2	Natufian?/Kebaran?
Kebara	C? V23d	395–400	14,500		250	OxA-2799	bone		Kebaran?
Kebara	I-R15a		32,200		630	Pta-4268	charcoal	-25.4	Levantine Aurignacian
Kebara	I-R17b	subsurface	22,900		250	Pta-4247	charcoal	-25.0	Levantine Aurignacian
Kebara	I-R15c	base	34,510		740	OxA-3974	charcoal	-24.9	Levantine Aurignacian
Kebara	II-Q16d	top	33,920		690	OxA-3975	charcoal	-25.6	Levantine Aurignacian
Kebara	II-R17d	burrow	28,700		450	Pta-4269	charcoal	-25.2	Levantine Aurignacian
Kebara	Iif-Q16d		36,000		1,600	OxA-1230	charcoal		Levantine Aurignacian
Kebara	Iif-Q14d	hearth	34,300		1,100	Gif-TAN-90028	charcoal		Levantine Aurignacian
Kebara	IIf	hearth	42,800		4,800	Gx-17276	charcoal		Levantine Aurignacian
Kebara	IIf	above hearth	32,670		800	Gif-TAN-90151	charcoal		Levantine Aurignacian
Kebara	II	burrow	31,400		480	Pta-4263	charcoal		Levantine Aurignacian
Kebara	IIIA-Q17d		31,400		480	Pta-4263	charcoal	-25.1	Early Ahmarian
Kebara	IIIBf-Q16d		42,500		1,800	Pta-5002	charcoal	-25.3	Early Ahmarian
Kebara	IIIBf-Q16d		42,100		2,100	Pta-4987	charcoal	-26.1	Early Ahmarian
Kebara	IIIBf-Q15		>43,800			OxA-3977	charcoal	-26.2	Early Ahmarian
Kebara	IIIBf		35,600		1,600	OxA-1567	charcoal		Early Ahmarian
Kebara	IIIBf-Q17b/d		36,000		1,100	Pta-4267	charcoal	-25.4	Early Ahmarian
Kebara	IIIBf-Q18b		43,500		2,200	OxA-3976	charcoal	-23.8	Early Ahmarian
Kebara	IIIBf-Q16d		>42,500			Gif-TAN-90037	charcoal		Early Ahmarian
Kebara	IIIBf		>41,700			Gif-TAN-90168	charcoal		Early Ahmarian
Kebara	IIIB		36,100		1,100	Pta-4267	charcoal		Early Ahmarian
Kebara	IVB-Q16d		28,890		400	OxA-3978	charcoal	-24.6	Early Ahmarian
Kebara	IVB		42,500		1,800	Pta-5002	charcoal		Early Ahmarian

Site	Level/Square	Height/Spit	Date bp	±	sd	Lab.	Material	$\delta^{13}C$ ‰	Tentative Cultural Assignment
Kebara	IVB	burrow	42,100		2,100	Pta-4987	charcoal		Early Ahmarian
Kebara	IVB		28,890		400	OxA-3978	charcoal		Early Ahmarian
Kebara	IV/V- Q16b/Q15d		43,700		1,800	Pta-5141	charcoal		Early Ahmarian
Kebara	W23c	400–405	33,500		930	OxA-2800	bone		Early Ahmarian
Kebara	Level 26 (lower E)		20,450		300	RT-227	ash		?
Wadi Hammeh 26			19,500		600	SUA-2101	charcoal		Late Kebaran
Wadi Hammeh 51			16,820		340	ANU-8471	shell		?
Wadi Hammeh 52			19,480		500	ANU-4653	shell		?
Tabaqat al-Buma	B20-2S	bag 22	11,170		100	TO-987	bone		Late Kebaran
Tabaqat al-Buma	B20-2S	bag 26	13,110		130	TO-989	bone		Late Kebaran
Tabaqat al-Buma	B20-2S	bag 30	14,850		160	TO-991	bone		Late Kebaran
Tabaqat al-Buma		519	12,660		430	TO-2116	bone		Late Kebaran
Urkan e-Rubb IIa			14,440		150	OxA-1503	charcoal		Early Kebaran
Urkan e-Rubb IIa	T-I/n.sect.		14,800		130	OxA-2839	charcoal	-25.1	Early Kebaran
Urkan e-Rubb IIa	T-I/n.sect.		15,190		130	OxA-2835	charcoal	-24.7	Early Kebaran
Urkan e-Rubb IIa	T-I	200	14,880		120	OxA-2840	charcoal	-25.5	Early Kebaran
Urkan e-Rubb IIa	P/Q20	200	14,980		200	OxA-2842	charcoal	-26.1	Early Kebaran
Urkan e-Rubb IIa	P18	215–220	14,860		130	OxA-2836	charcoal	-23.5	Early Kebaran
Urkan e-Rubb IIa	U13c	151	14,650		120	OxA-2837	charcoal	-25.1	Early Kebaran
Urkan e-Rubb IIa	U14a	150–155	15,730		130	OxA-2841	charcoal	-23.5	Early Kebaran
Urkan e-Rubb IIa	I12c	125–130	15,050		160	OxA-2838	charcoal	-24.6	Early Kebaran
Fazael IX			17,660		160	OxA-2871	charcoal	-25.9	Atlitian
Fazael X	M10b-c	80-85	15,450		130	OxA-2870	charcoal	-25.7	Masraqan/Late Ahmarian
Wadi Hisban 2			14,052		94	Wk-7005	charcoal		Nizzanan
Wadi Hisban 2			11,560		250	ANU-8469b	bone		Nizzanan
Wadi Hisban 2			9,490		220	ANU-8469a	bone		Nizzanan
Uwaynid 14 upper	Sq. 10	15	18,900		250	OxA-865	charcoal		Qalkhan
Uwaynid 14 middle	Sq. 5	18	18,400		250	OxA-866	charcoal		Nebekian
Uwaynid 18 upper	Sq. 5	15B	19,800		350	OxA-864	charcoal		Nebekian
Uwaynid 18 upper	Sq. 1	3K	19,500		250	OxA-868	charcoal		Nebekian
Uwaynid 18 lower	9/19a	hearth	23,200		400	OxA-867	charcoal		Masraqan/Late Ahmarian
Azraq 17	Trench 2/ Sq.11		13,260		200	OxA-869	charcoal		Masraqan/Late Ahmarian
Kharaneh IV	Phase D, A	19.37	15,200		450	KN-4192	?		Nizzanan

Site	Level/Square	Height/Spit	Date bp	±	sd	Lab.	Material	$\delta^{13}C$ ‰	Tentative Cultural Assignment
Kharaneh IV	Phase D, A	19.37	15,700		160	KN-4193	?		Nizzanan
Wadi Jilat 6	Phase A Sq. 4	8A	15,520		200	OxA-524	charcoal		Nizzanan
Wadi Jilat 6	Phase A Sq. 1	5A	16,010		200	OxA-525	charcoal		Nizzanan
Wadi Jilat 6	Phase A Sq. 1	8A	15,470		130	AA-5492	charcoal		Nizzanan
Wadi Jilat 6	Phase A Sq. 1	7B	16,575		120	AA-5491	charcoal		Nizzanan
Wadi Jilat 6	Phase A Sq. 2	3A	16,695		120	AA-5493	charcoal		Nizzanan
Wadi Jilat 6	Phase A Sq. 3	9A	16,700		140	AA-5494	charcoal		Nizzanan
Wadi Jilat 6	Phase B Sq. 4	12A	11,740		80	OxA-522	charcoal		Qalkhan
Wadi Jilat 6	Phase B Sq. 2	12A	11,450		200	OxA-523	bone		Qalkhan
Wadi Jilat 6	Phase C Sq. 1	14A	7,980		150	OxA-539	charcoal		Nebekian
Wadi Jilat 9	1/2a		21,150		400	OxA-519	bone		Masraqan/Late Ahmarian?
Thalab al-Buhira – EHLPP2		Area C-K3/3	25,680		100	Beta-129818	charcoal		Early Ahmarian
Thalab al-Buhira – EHLPP2		Area E-B5/4	24,900		130	Beta-129817	charcoal		Early Ahmarian
Yutil al-Hasa upper WHS784X		A/L.2A	19,000		1,300	UA-4396	charcoal		Masraqan/Late Ahmarian
Yutil al-Hasa lower WHS784		A/19	22,790		80	Beta-129813	charcoal		Masraqan/Late Ahmarian
Ain al-Buhira spring WHS618			*18,960*		*580*	*Beta-55933*	*sediment*		*Masraqan/Late Ahmarian*
Ain al-Buhira spring WHS618	*E68*	*Upper*	*20,670*		*600*	*Beta-118757*	*sediment*		*Masraqan/Late Ahmarian*
Ain al-Buhira spring WHS618	*Test I*	*Upper*	*20,300*		*600*	*UA-4395*	*sediment*		*Masraqan/Late Ahmarian*
Ain al-Buhira spring WHS618		*Upper*	*23,500*		*270*	*Beta-56424*	*sediment*		*Masraqan/Late Ahmarian*
Ain al-Buhira – WHS618	*Area F*		*25,950*		*440*	*Beta-55928*	*sediment*		*Early Ahmarian*
Tor Sageer lower WHNBS242	D3	L. 7	20,330		60	Beta-129809	charcoal		Nebekian
Tor Sageer lower WHNBS242	B3	hearth	20,840		340	Beta-129811	charcoal		Nebekian
Tor Sageer lower WHNBS242	B4	hearth	22,590		80	Beta-129810	charcoal		Nebekian
Wadi Hasa 1065	Test B	L/7	15,580		250	UA-4392	charcoal		Nizzanan
Wadi Hasa 1065	Test B	L/8	15,860		430	UA-4394	charcoal		Nizzanan
Wadi Hasa 1065	Test C	L/13	16,570		380	UA-4390	charcoal		Nizzanan
Wadi Hasa 1065	Test C	L/13	16,790		340	UA-4393	charcoal		Nizzanan
Wadi Hasa 1065	Test A	L/5	16,900		500	AA-4391	charcoal		Nizzanan
Wadi Hasa 1065			16,670		270	Beta-57900	charcoal		Nizzanan
Wadi Hasa 1065			9,010		100	Beta-57898	sediment		Nizzanan
Wadi Hasa 1065			11,280		290	Beta-57899	sediment		Nizzanan
Wadi Madamagh	A2		14,300		650	KN-3593	bone		Nebekian
Wadi Madamagh	D1	lower	15,300		600	KN-3594	bone		Unnamed – Arqov/Divshon?
Hamifgash IV		hearth	16,230		200	OxA-2143	charcoal	-23.2	Nizzanan

Site	Level/Square	Height/Spit	Date bp	±	sd	Lab.	Material	$\delta^{13}C$ ‰	Tentative Cultural Assignment
Hamifgash IV		hearth	5,820		120	RT-1056	charcoal		Nizzanan
Shunera XVI		palaeosol	22,200		400	RT-1084N	carbonate		Masraqan/Late Ahmarian
Shunera XVI	M24-25		16,200		170	RT-1072N	ostrich		Masraqan/Late Ahmarian
Shunera XVI	N25a	0–15	16,100		150	Pta-3703	ostrich	-9.0	Masraqan/Late Ahmarian
Shunera XVI	M24-25		15,800		160	Pta-3702	ostrich	-9.1	Masraqan/Late Ahmarian
Shunera XVI		hearth	102		2	RT-1069	charcoal		Masraqan/Late Ahmarian
Shunera XVII		hearth	1,320		80	OxA-2139	charcoal	-12.1	Late Kebaran?
Azariq XIII		hearth	10,700		230	RT-1081	charcoal		Masraqan/Late Ahmarian
Azariq XIII		hearth	15,160		190	OxA-2142	charcoal	-11.4	Masraqan/Late Ahmarian
Azariq XIII		palaeosol	19,700		400	RT-1105	carbonate		Masraqan/Late Ahmarian
Boker BE	Level I		25,250		345	SMU-566	charcoal		Unnamed – Arqov/Divshon?
Boker BE	Level I		25,610		640	SMU-186	charcoal		Unnamed – Arqov/Divshon?
Boker BE	Level II		24,630		390	SMU-565	charcoal		Early Ahmarian
Boker BE	Level II		26,950		520	SMU-227	charcoal		Early Ahmarian
Boker BE	Level III		26,030		600	SMU-228	charcoal		Early Ahmarian
Boker BE	Level III		26,660		500	SMU-229	charcoal		Early Ahmarian
Boker BE	Level III		27,450		1,300	SMU-188	charcoal		Early Ahmarian
Boker A	Level 1		37,920		2,810	SMU-578	charcoal		Early Ahmarian
Boker A	Level 1		>33,420			SMU-260	charcoal		Early Ahmarian
Boker A	Level 1		>33,400			SMU-187	charcoal		Early Ahmarian
Boker Tachtit	Level 1		47,284		9,048	SMU-580	charcoal		Transitional/Emiran
Boker Tachtit	Level 1		46,930		2,420	SMU-259	charcoal		Transitional/Emiran
Boker Tachtit	Level 1		>45,570			SMU-184	charcoal		Transitional/Emiran
Boker Tachtit	Level 1		>34,950			GY-3642	charcoal		Transitional/Emiran
Boker Tachtit	Level 4		35,055		4,100	SMU-579	charcoal		Transitional/Emiran
Ein Aqev (D31)	Level 5		16,900		250	I-5494	charcoal		Unnamed – Arqov/Divshon?
Ein Aqev (D31)	Level 7		17,510		560	I-5495	charcoal		Unnamed – Arqov/Divshon?
Ein Aqev (D31)	Level 9		17,890		600	SMU-6	charcoal		Unnamed – Arqov/Divshon?
Ein Aqev (D31)	Level 11		17,390		560	SMU-8	charcoal		Unnamed – Arqov/Divshon?
Ein Aqev (D31)	Level 12		19,980		1200	SMU-5	charcoal		Unnamed – Arqov/Divshon?
Site A306a			27,100		410	Pta-2950	ostrich		Early Ahmarian
Qseimeh I			34,010		510	DRI-2965	ostrich	-8.7	Early Ahmarian
Qseimeh I	with 13C/12 correction		34,280						Early Ahmarian
Qseimeh II			30,500		330	DRI-2966	ostrich		Unnamed – Arqov/Divshon?

Site	Level/Square	Height/Spit	Date bp	±	sd	Lab.	Material	δ^{13}C ‰	Tentative Cultural Assignment
Qseimeh II	with 13C/12 correction		30,800						Unnamed – Arqov/Divshon?
Qadesh Barnea 601B			32,470		780	Pta-2964	ostrich		Early Ahmarian
Qadesh Barnea 501			33,800		940	Pta-2819	ostrich		Early Ahmarian
Gaiyfa X			19,525		199	DRI-3001	charcoal	-15.5	Nebekian
Gaiyfa X	with C4 correction		19,680		199				Nebekian
Lagama IIID			30,050		1,240	SMU-118	ostrich		Masraqan/Late Ahmarian
Lagama IIID	with 13C/12 correction		30,360						Masraqan/Late Ahmarian
Lagama VII			34,170		3,670	SMU-172	charcoal		Early Ahmarian
Lagama VII			31,210		2,780	SMU-185	charcoal		Early Ahmarian
Lagama VII			>19,900			RT-413A	charcoal		Early Ahmarian
Lagama VIII			32,980		2,140	SMU-119	ostrich		Early Ahmarian
Lagama VIII	with 13C/12 correction		33,290						Early Ahmarian
Abu Noshra I			>30,440			B-12125	charcoal		Early Ahmarian
Abu Noshra I			29,580		+1,610/-1,340		B-13898	charcoal	Early Ahmarian
Abu Noshra I			*25,950*		*360*	*B-13897*	*sediment*		*Early Ahmarian*
Abu Noshra I			31,330		2,880	SMU-1824	charcoal		Early Ahmarian
Abu Noshra I			35,824		1,090	SMU-2254	charcoal		Early Ahmarian
Abu Noshra I				35,805		1,520	SMU-2007	charcoal	Early Ahmarian
Abu Noshra II			31,023		8,537	SMU-1772	charcoal		Early Ahmarian
Abu Noshra II			31,585		2,275	SMU-1762	charcoal		Early Ahmarian
Abu Noshra II			33,470		680	ETH-3075	charcoal		Early Ahmarian
Abu Noshra II			33,940		790	ETH-3076	charcoal		Early Ahmarian
Abu Noshra II			38,924		1,529	SMU-2122	charcoal		Early Ahmarian
Abu Noshra II			48,250		2,810	SMU-2372	charcoal		Early Ahmarian
Abu Noshra VI			31,100		300	SMU-2371	charcoal		Early Ahmarian

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